

No. 16.

1907.

(UNIVERSITY OF LONDON.)

COUNTY COUNCILS OF KENT & SURREY.

THE JOURNAL
OF THE
South-Eastern Agricultural College,
WYE, KENT.

HEADLEY BROTHERS,
PRINTERS AND PUBLISHERS,
LONDON: AND ASHFORD, KENT.

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EDITORIAL NOTES.

The increasing use which is made of the College as an advisory centre on matters concerning agriculture and horticulture, results in the increased size of the College Journal, where the experiences of our correspondents and our answers to their inquiries are recorded, and it is probable that in future years each department of the work of the College will have its special Journal, which will be issued to those interested in each separate sphere of work.

The number of students attending the College continues to increase, and in the year under review a "record" is again established (1114). It has been remarked that it is somewhat of an anomaly for the College to be described in successive journals as full, and yet for the number of students to go on increasing yearly. The explanation of this is to be found in the fact that the number of students actually resident in College is limited by the accommodation to fifty-four, six can also be taken at the farm houses, but the number which can be received in addition is entirely dependent upon the amount of lodging accommodation which can be found in the village, and each year an increasing number of residents in the village make arrangements to receive students. The number which can be satisfactorily dealt with in the present laboratories, lecture rooms, etc., must not exceed 120.

The Departmental Committee which was appointed to inquire into the conditions of Agricultural Education and Research in this country, is now nearing the completion of its labours, and it is hoped that its recommendations will cause these important subjects to be placed on a definitely established footing as regards State assistance. The fabric of Higher Agricultural Education has been raised in this country in a somewhat disjointed way; some continuity

has been secured and overlapping prevented, by the action of the Board of Agriculture, which has supplemented local efforts, but there is much to be done yet, both in the assistance of the work of existing colleges, and in the establishment of colleges to serve districts which at present have no college or institution where agricultural investigation is being carried on. A thoughtful and practical paper was read at the Farmers' Club, by Mr. Hall, on the subject of "Agricultural Education," but it cannot be said that in the discussion which ensued there was much in the way of suggestion or criticism which would be of service in adding to existing knowledge on the subject. Short courses have undoubtedly an important place in any scheme of agricultural education, as being suited to small farmers' sons and to those who have not the time to attend the ordinary certificate or diploma courses. Such courses would undoubtedly be established at Wye were there room for the additional students, but it is doubtful whether it would even then be expedient to attempt to carry on so many different classes of instruction in the same college. A suggestion has recently been made, which if carried out would probably have excellent effects upon the teaching in the rural schools, that teachers who have been through the ordinary two years training college course, and who have shown their aptitude for rural teaching, should receive a third year of instruction at Wye or at a similar college, for the purpose of demonstrating to them the ways in which science may be applied to the phenomena of country life, and also to give them some training in those subjects, especially horticulture, which ought to be taken up in all rural schools. From the national education point of view there is much to be said for such a suggestion; financial difficulties may occur in the case of the teachers, but provided that these can be overcome, and residential accommodation could be afforded at Wye, there is no reason why such a course should not be established, as the proper training of rural teachers in subjects and methods which are particularly suitable for rural schools, would have an immensely valuable effect on the education of country children.

Mr. F. V. Theobald, the Vice-Principal, has received the honour of the Imperial Order of the Osmanie from the Khedevial

Government in recognition of his work for the Sudan and Nile Provinces; he has also been appointed member of the Council of Imperial Medicine and Hygiene.

Mr. Escombe resigned the post of Botanist, and was succeeded by Mr. Parkinson, who had already done much useful work for the College as Assistant Botanist.

Mr. C. A. Ealand has been appointed Lecturer in Botany, etc., at the Chelmsford Technical School for Agriculture, under the Essex County Council. Mr. B. N. Wale, B.Sc. (Agric.), Lond. Univ., Silver Medallist, R.A.S.E., Camb. Univ., Dip. Agric., has succeeded Mr. Ealand.

Mr. Orwin has been succeeded by Mr. A. H. J. Haines, P.A.S.I., who as sub-agent on Lord Heytesbury's estate, and Lecturer on Surveying at the Uckfield College, has had an excellent experience—his qualifications as a cricketer will also make him a welcome addition to the College staff.

Mr. Annett obtained his B.Sc. (Agric.) at London University, in October, 1906, and was appointed Analytical Assistant in the laboratories—he was, in February, 1907, offered an appointment as Agricultural Chemist in the Indian Agricultural Department's Experiment Station at Pusa, which he accepted, and sailed for his new duties in April. Mr. Annett has the best wishes of all connected with the College for his future success. Mr. C. T. Gimmingham, F.I.C., has succeeded Mr. H. E. Annett.

Mr. C. H. Hooper, F.S.I., has been appointed Librarian.

Mr. H. W. Harding has gone into partnership with Mr. G. B. Wallace, in ranching in the Okanagan Valley, British Columbia, and has resigned his post as Practical Instructor at the College.

Mr. G. H. Garrad, P.A.S.I., N.D.A., was appointed Farm Manager to Mr. Herdman, at Hawkhurst, but resigned this on being appointed Supernumerary Agriculturist on the Pusa (Indian Agricultural Department) Staff.

Mr. C. W. Mason has also gone to Pusa, on the Entomological Staff.

Mr. J. F. Harrison, N.D.A., is managing a farm at Hastingleigh, for Mr. Fels.

Mr. H. P. Easten has been appointed Lecturer in Dairying and Poultry, and Mr. J. B. Love, Lecturer in Surveying at the Holmes Chapel Agricultural College.

Mr. C. W. Fisher is Assistant Conservator of Forests in Ceylon ; Mr. H. E. Pollock Hodson, Deputy Inspector under the Agriculture and Lands Department, Sudan Government.

Mr. H. Mundy is one of Mr. F. B. Smith's assistants in the Transvaal Department of Agriculture, and we hear of Mr. J. O. Swinford's success as a prize winner in butter-making in South Africa.

Mr. A. D. McKinstry, P.A.S.I., N.D.A., is going to Egypt to take up an appointment under the Aboukir Land Company.

Mr. K. G. Furley has been appointed by the Worcestershire County Council to conduct certain trials on spraying for Apple Sucker, and to investigate the occurrence of the American Gooseberry Mildew.

Mr. F. G. Jackson is working under the North Borneo Trading Company.

Mr. N. C. Leatham has been appointed assistant engineer on the Manila Railway, Philippine Islands.

Mr. C. W. Walker Tisdale has been appointed Manager of the Wensleydale Pure Milk Society.

Mr. S. Colyer is managing Ockham and Udiam Farm for Messrs. Guinness.

Mr. H. B. Amos, who is farming at Ripton, Ashford, was a very successful exhibitor at the Ashford Christmas Show, winning several prizes for Sussex cattle and corn.

Mr. C. W. R. Blatherwick is also a successful exhibitor of Herefords.

Mr. Lang, the farm bailiff, was appointed to an agency in Sussex, and is followed by Mr. J. Morison, who has had considerable experience in farming in Cheshire, Suffolk, Surrey, and Sussex.

In the May, 1907, National Diploma Examination, the following were successful :—

First Part.—Messrs. W. N. Harvey, L. R. de Eizaguirre, R. H. Carter.

Second Part.—A. D. McKinstry.

In the Surveyors' Institution, Professional Associate Examination, 1907, the following passed :—Hon. I. Campbell, Messrs. R. N. Dowling, W. H. A. FitzRoy, C. R. G. Mitchell, A. M. Taylor, whilst Mr. G. H. Grellier obtained his Fellowship.

All old students of the College who remember the late Matron, Miss Machattie, will feel the deepest sorrow at her tragic death from a burning accident on February 8th.

It is somewhat sad to have to report so many appointments, which result in some of the best of our students leaving England but the prospects with regard to salary and pension are so attractive that a young man starting life is not to be blamed for accepting such positions. It is, however, most satisfactory to hear good reports of those students who are farming at home, and although the Colonial appointments are made more public, it must not be inferred that a large percentage of students go to the Colonies—by far the greater number stay in this country, and as Mr. Hall said at the *Agricola Club Dinner*, "They are doing their best, often with little help or recognition, to maintain the business and practice of agriculture in this country at a high level of efficiency."

We must congratulate the editor of and contributors to the eleventh number of the *Agricola Club Journal* on a most interesting and successful issue. We are indebted to this *Journal* for most of the details with regard to past students which appear in these notes. The *Journal* is an excellent evidence of the virility of the old students' club, which every student leaving the College should join, not only for the sake of the *esprit de corps*, but for his own advantage.

Mr. E. S. Salmon, whose appointment as Mycologist was noted in the last number of the *Journal*, has soon given evidence of his energy in turning his extensive knowledge of fungi to practical account for the benefit of fruit growers in this country. The detection of the outbreaks of American Gooseberry Mildew by him was followed by an energetic and tactful campaign to bring about the stamping out of the disease, and his efforts have been rewarded by the introduction of the Bill dealing with fungus attacks into the House of Lords, which has now passed the third reading in the Commons.

The City Companies have recognised the claims of the College in a generous way: the Mercers' and Goldsmiths' Companies have

each made a grant of fifty guineas, and the Drapers' Company a grant of ten guineas to the College Funds. All interested in agricultural research will thoroughly appreciate the magnificent generosity of the Goldsmith's Company in making a grant of £10,000 to the Rothamsted Experiment Station, and will congratulate Mr. Hall on the splendid acknowledgment of the work of the station.

We have no wish to depreciate in any way any legitimate agitation and stronger action, if necessary, in favour of compelling the purity of all food materials, but the so-called "arsenic" scare with regard to beer is being used by unscrupulous manipulators in order to influence the price of hops, and to cause an insistence on a freedom from arsenic in hops as unnecessary as it is illogical. It must not be forgotten that the original "arsenic scare" with regard to beer arose entirely from the use of a cheap contaminated glucose by certain brewers as a substitute for malt sugar, and it is highly probable that had beer been brewed solely from malt and hops we should have had no trouble at all with regard to the arsenic question. It has been urged that as little as possible should be said with regard to arsenic in beer manufacture, for fear of destroying the confidence of the public in beer, and so reducing the consumption, but from conversations we have had with some of the hard-headed Lancashire men, whose partiality for beer is well known, the falling off in the consumption of beer is due to the knowledge that it is not a pure malt and hop liquor, and some of the working-men's clubs in the north are decreasing their consumption of beer and consuming more spirits, owing to their being unable to get beer "brewed pure," as they term it. When we consider the quantity of hops used in brewing, it is seen how illogical it is to insist on the same freedom from arsenic in the case of hops, as in other brewing materials, malt or glucose.

An examination of the analyses made by the Chemist to the Royal Commission on Arsenic Poisoning shows that the proportion of samples of malt contaminated by arsenic was far greater than in the case of hops, and also that the degree of contamination was greater. But assuming the incorrect and unwarranted view that both are equally liable to arsenic contamination, the quantity

of malt used in brewing is roughly forty-two times the quantity of hops used, so that if we admit that 1-100 gr. per lb. is a sound and legitimate limit for the arsenic contamination of malt, that of hops, to put the two brewing materials on an equally good footing, should be between $\frac{1}{2}$ and $\frac{1}{3}$ gr. per lb.

The presence of arsenic in hops is practically entirely due to the fuel used in the drying process, in which the green hops are exposed to the heat from an open fire some eight feet from the horsehair cloth on which the hops are spread. The arsenic occurs in lumps or nodules and in the arsenical pyrites in the coal, and is very unevenly distributed in the mass of the coal. It is quite impossible to guarantee a coal absolutely free from arsenic, on account of the difficulty in sampling such a material, but the quantity of arsenic that may be introduced by the use of a high class coal is so small as to be negligible in amount and in its action on the beer consumer. To insist on an absolute freedom from arsenic would be to make it necessary to dry hops on a hot air system, and this would involve a very serious expenditure, which would absolutely cripple the industry, without any real corresponding advantage to the beer consumer, and to the great interest and advantage of the foreign hop grower, whose hops are partly sun-dried and "finished" by hot air. It must not be concluded that this dislocation of an industry, with possible ruin to the small grower, would be considered if the health of the beer drinking community depended on it, but these results would ensue on account of an unwarranted and unscientific exaggeration of the facts of the case.

Although it is freely stated that the legal limit for arsenic in hops is 1-100 gr. per lb., such a limit does not exist. In the case of glucose such a limit is insisted on by the Somerset House authorities, and glucose to be used for food purposes (brewing included), if found to contain more than this quantity, is condemned. No such action can be taken in the case of malt or hops.

There is evidence that the presence of a greater quantity of arsenic than 1-100 gr. per lb. has been used as a reason for depressing the price of a consignment of hops, and that these same hops have been subsequently purchased and used for brewing purposes at the

lower figure. If the hops are poisonous at £6 10s. per cwt., they are equally poisonous at £4 15s.

Doubt has often been cast on the accuracy of the work of an analyst, when from the same consignment of hops samples are drawn which on analysis contain widely differing amounts of arsenic. The accurate estimation of quantities, traces they may almost be called, of arsenic, amounting to 1-50 to 1-100 gr. per lb., is a matter of extreme difficulty, and the satisfactory sampling of hops for analytical purposes presents also very considerable difficulties, as from imperfect mixing of the dried hops on the cooling floor, or from the sample containing a considerable proportion of dust, it may be that the sample drawn may be entirely unrepresentative of the bulk. No method of sampling can be considered satisfactory unless at least three or four samples are taken from each pocket, and after thoroughly mixing, furnish the sample for analysis. This method in the case of a grower sending in 400 or 500 pockets would be impracticable, and it is questionable whether it would be very accurate. Supposing, however, that it were possible to sample satisfactorily, and to estimate with absolute accuracy quantities of 1-40 to 1-1,000 gr., is it necessary?

There is every evidence that growers are using the utmost precaution to ensure the freedom from arsenic of their hops, and in the case of an industry in which £40 to £60 per acre is spent, it is not likely that any false economies will be practised, and the safety of the beer-drinking public would be amply secured by the arsenic limit being increased to 1-20 grain per lb., an amount it would be practically impossible to reach if only ordinary precautions as to fuel were taken.

M. J. R. DUNSTAN.

REPORT ON THE FARM AND GARDENS.

By M. J. R. DUNSTAN, M.A., F.R.S.E., V. S. RAWSON,
AND W. R. TUCKER.

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REPORT ON THE FARM AND GARDENS.

By M. J. R. DUNSTAN.

The year has not been an entirely favourable one for the farm: the severe weather at lambing time left its effects on the sheep, and the condition of the lambs was not equal to that obtaining in former years. The grass showed excellent promise until the end of June, when the drought set in, and lasted practically until the end of September, making it exceedingly difficult for us to keep up our milk yield, and the considerable head of horned stock which the flush of grass had been bringing along well, rapidly went back in condition, and instead of being sold in October, had to be retained through the winter, store stock prices being at a ruinously low figure. These bullocks were during the winter put out to keep on Coombe Farm at $4\frac{1}{2}$ d. per head per week, we finding cotton cake, and were sold in April at Ashford market at fair prices averaging about 29s. per cwt. live weight. Beef has been a bad trade throughout the year; mutton and pork have, however, sold well; the wool was sold by auction at Guildford and realised 15d. for Downs, 13 $\frac{3}{4}$ d. Kents, and 9 $\frac{3}{4}$ d. Lambs.

Mangels and swedes were average crops; the late sown swedes and turnips after catch crops suffered from the drought; seeds hay was good, and got in excellent order. Corn all round was a satisfactory crop, and the yield of straw and grain was above average.

The varieties and yields are as follows:—

Wheats.—Red Fife, 5 qrs.; White Fife, $4\frac{1}{2}$ qrs.; Essex Conqueror, 5 qrs.; Red King, $4\frac{1}{2}$ qrs.; Standard Red, $4\frac{1}{2}$ qrs.; Square-head Master, 4 qrs. Wheats were sold at 35s. to 35s. 6d. for milling, May, 1907; 36s. to 48s. for seed, November, 1906.

Barleys.—Kinver Chevalier, 5 qrs. ; Chevalier (Hallett's), $5\frac{3}{4}$ qrs. ; Standwell, $4\frac{1}{4}$ qrs. Barleys were sold at 28s. 6d., March, 1907.

Oats.—Beseler's Giant, $6\frac{1}{2}$ qrs. ; Mounted Police, 8 qrs. ; Newmarket, $7\frac{1}{2}$ qrs. ; Potato, 7 qrs. ; Dalmeny, 9 qrs. ; Thousand Dollar, 10 qrs. ; Wideawake, 8 qrs. ; Black Tartars, $9\frac{1}{2}$ qrs. ; Anglesey, 10 qrs. Oats were sold at 24s. to 26s. for seed, February, 1907.

Beans averaged 4 qrs.

The experiments on the Farm consisted mainly of demonstrations for showing students the influences of manures on the different farm crops, the relative values of various typical varieties of corn and roots grown under local conditions, systems of cultivation, etc.

LIVE STOCK.

SHEEP.

The sheep on the Farm consisted of a pure breeding flock of Southdown ewes and also of Romney Marsh ewes, ewes of typical English breeds being kept as well. The best doers are undoubtedly the sheep of the district, Romney Marsh and Southdowns. The appearance of the Oxfords, Lincolns and Suffolks is an excellent object lesson to the students that local conditions do not suit equally every breed.

Two pens of sheep were shown at the Ashford Fat Stock Show, Southdown wether tegs and cross bred (Shropshire-Kent) lambs. The Southdowns secured the first award in their class and also the Cup for the best pen of sheep (tegs) in the show other than Kents. This, our first attempt with Southdowns was most successful, and reflects great credit on the shepherd, Denyer. The carcass sent (Southdown-Suffolk) secured a minor award. Seventeen Southdown ram lambs were sold at average prices from £2 15s; ram tegs £4 4s.

The three Southdown rams used were from the Goodwood and Summersbury flocks, and the three Kent rams were of the well known breeders, Messrs. A. Amos, F. Neame and J. E. Quasted; the ram which sired the winning College pen of Southdowns was that lent to us by Mr. Edwin Ellis two seasons back.

The effect of shearing lambs was again tested this season as regards the clip :—

10 tegs (shorn as lambs) gave 52 $\frac{1}{4}$ -lbs. wool.

10 tegs unshorn „ 59 „ „

or an average increase of 10.8 ounces of wool in the case of those sheep shorn only once.

The lambs, as has been already mentioned, were not a good lot, and the wethers were fatted and sold in January. The Suffolk cross came earliest for killing among the lambs, but in the older sheep the Hampshire Cross proved superior.

The sheep breeding trials and the lambing results are as under :—

RAMS.	EWES.	Total No. put to ram.	Died since.	Barren.	Ewes had lambs.	No. of lambs.
Southdowns	Southdown ewes	.. 111	5	7	99	125
	Suffolks „	.. 6	1	0	5	9
	Kent „	.. 13	0	7	6	7
	Southdown-Suffolk ewes	3	0	0	3	4
Kent	Kent ewes	.. 102	4	17	81	105
	Lincoln „	.. 5	0	1	4	3
	Oxford „	.. 9	1	0	8	8
	Suffolk „	.. 6	0	1	5	8
	Southdown-Kent ewes	2	0	0	2	3
Suffolk	Lincoln ewes	.. 5	1	1	3	4
	Kent „	.. 10	0	0	10	11
Hampshire	Kent ewes	.. 13	0	1	12	14
Shropshire	Kent „	.. 10	0	0	10	10
Totals		.. 295	12	35	248	311
Per cent.		..	4.06	11.8	84.06	125.4
						to 100 ewes lambd.

The number of barrens, especially among the Kents, is higher than the average.

CATTLE.

The horned stock on the Farm comprised the herd of Lincoln Red Shorthorn cows, which were put to the Evens bull, Wye College Rufus (bull calves of this strain made prices of from five to six guineas at ten days old) ; Aberdeen Angus and Galloway Cows put to the White Shorthorn bull to breed the blue greys; Sussex, Guernsey, and Ayrshire cows and some Cumberland Shorthorns also put to the Red Bull.

The yields of the registered Lincoln Red Shorthorn cows is as follows :—

No. 1.	11719.1 lbs.	5th calf.	62 weeks in milk.	} Exclusive of milk consumed by suckling calves.
7.	6790 lbs.	5th calf.	55 weeks in milk.	
11.	5424.3 lbs.	2nd calf.	51 weeks in milk.	
12.	4474.2 lbs.	2nd calf.	37 weeks in milk.	
13.	6573.2 lbs.	2nd calf.	44 weeks in milk.	
14.	5448.1 lbs.	2nd calf.	41 weeks in milk.	
15.	6538.1 lbs.	2nd calf.	39 weeks in milk.	
16.				
17.	5457.1 lbs.	2nd calf.	44 weeks in milk.	
18.	5542.2 lbs.	2nd calf.	42 weeks in milk.	
19.	3278 lbs.	1st calf.	38 weeks in milk.	

PIGS.

The Pigs on the Farm were Large and Middle White Yorkshire, Tamworth and Large Blacks. The boars used were a Large White and Large Black, but we have been particularly unfortunate with our Large White Boars, never having secured a really satisfactory animal.

A serious misfortune befell the breeding sows—five being poisoned, owing to some poisonous material being put into the College swill tubs. Chemical analysis and a veterinary investigation failed to reveal the nature of the poison.

FEEDING TRIALS.

CATTLE.

The feeding trials during the winter of 1906-7 were designed as a demonstration of the comparative feeding and money values of home-grown and foreign foods.

Ten bullocks were selected and divided into five pairs—one of each pair was fed on a ration of roots, hay and chaff, with a “Foreign food,” mixture of linseed and cotton cakes, and maize germ meal, whilst the “Home grown” mixture contained bean, wheat and barley meals of the same albuminoid ratio as the foreign food. The cost of the rations were, Foreign, £6 10s. 6d. per ton; Home grown, £7. The feeding was continued for twenty weeks, and the average gain of the foreign lot over the home grown was 29lbs. per bullock. It is unnecessary to go into details with the figures, sufficient to say that with markets ruling as they did in 1906-7, there is little to choose between the foods—the linseed cake bullocks finished and handled rather better than the meal bullocks, and there is the advantage that where no compensation is allowed for home-grown produce fed on the farm the money manurial value of the foreign foods may help out the feeding bill—a judicious blending of foreign cakes and home-grown meals would probably secure the most economical and best return, but as has been said before in a previous report, on the Coldharbour farm if not on other farms, winter feeding of bullocks does not pay unless stores can be bought very cheap, and beef is making more than 11s. 6d. per score.

PIGS.

A preliminary feeding trial was made with pigs to determine the relative feeding values of English and foreign barley.

In November it was possible to purchase foreign barleys at 20s. 9d. per quarter of 400 lbs., *i.e.*, £5 17s. 6d. per ton, whilst the second grade English barleys used in this trial were valued at 26s. per quarter of 448 lbs. or £6 10s. per ton. Three pens (similarly made up from different litters) each of five pigs were taken.

Pen A received at starting 2 lbs. per pig of Foreign barley meal. Pen B received at starting 2 lbs. per pig of English barley meal,

the third pen receiving a weight of English barley meal equivalent in money value to the meal received by Pen A—the pigs in this third pen proved such bad doers and the quantity of meal proved so obviously insufficient, that after sixteen weeks feeding they were taken out of the trial. The trial with Pen A and Pen B was continued for twenty weeks, and the results are as follows, they are merely recorded here as the result of one trial and too much reliance must not be placed on a single experiment.

	Fasted, Nov. 28. c. q. lbs.	Live Weights, Apr. 23. c. q. lbs.	Increase. c. q. lbs.	lbs. of Meal to 1lb. of increase.
Pen A.	2.0.10	7.2.12	5.2.2	4.233
Pen B.	2.0.8	7.1.0	5.0.20	4.510.

The pigs were sold by auction at Ashford, and the prices therefore are dependent on other conditions than weight—Pen A sold first made £15 4s. Pen B (sold later) made £12 3s.

The results require confirmation—the only suggestion that can be made is that pig feeders might well consider the purchase of foreign barley when its price is about 21s. per quarter for economical and efficient pig food. The value of the foreign barley meal as judged by its appearance would be little, as it appeared all “huck” or husk. Next season, when the trial is repeated, a careful analysis will be made of the meals, and the trial will be made on a larger number of pigs.

HOPS.

The Hops were a failure—a very severe and prolonged attack of fly set in at a time when Mr. Deadman was seriously ill, and the garden gave a miserable yield of less than 2 cwt. per acre.

THE ORCHARDS.

The Fruit season has not been a satisfactory one, the late frosts ruined the plum, damson, pear and cherry crops—gooseberries, raspberries, currants, and strawberries were an abundant crop, and apples about half a crop. The lower Fruit plantation is more affected by frosts than the Coldharbour plantation, and a better crop was secured in the latter garden.

VEGETABLE AND GLASSHOUSE DEPARTMENT.

The Vegetable Garden contains seven acres, one acre on the right of Occupation Road, including the glass, the rest on the left of the road joining the Hop Garden.

The acre on the right of the road was divided into five plots

Plot 1. Asparagus beds.

- „ 2. Experimental ground for the Chemical Department.
- „ 3. Single rows of different varieties of potatoes.
- „ 4. (Fenced in ground), early peas, beans, lettuce, vegetable marrows and tomatoes.
- „ 5. Strawberries (three years old).

The six acres on the left of Occupation Road were divided into five plots. :—

Plots 1 and 3. Late potatoes.

Plot 4. Early potatoes, rows 30 inches, intercropped with kales and early broccoli.

- „ 2. Three quarters of this was trenched and used for peas, followed by turnips; onions followed by cabbage; beetroot, sea kale, parsnips, etc., etc. Celery and cabbage were grown on the untrenched portion.
- „ 5. Rhubarb, artichokes, Brussels sprouts, leeks, salsify, and various other vegetables required in small quantities.

The Glass Department, though not large enough for the supply of the College, furnished good crops of fruits and plants.

The first division was cropped with cucumbers and melons for eight months, and in the four winter months winter flowering begonias, primulas, ferns, etc.

The second division gave an excellent crop of tomatoes, followed by chrysanthemums and other plants for winter use.

The third division was give up to American varieties of carnations, grown on the system which was first practised in the States, and now used by several of the leading market growers. Raised beds or benches were made so that warm air can circulate underneath, the beds being then filled with about 9 inches of

suitable compost. In June young plants were turned out of 3 inch pots and firmly planted at about 10 inches apart. Support is given to the plants and blooms by stretching a couple of thin wires between the rows of plants, both up and across the beds. "Mrs. T. W. Lawson," "Enchantress" and "Harry Fenn" were the varieties grown.

POULTRY.

The breeds of Poultry now on the farm are White Orpingtons, Salmon Faverolles, Speckled and Red Sussex, Old English Game, Turkeys, Geese and Ducks.

The crosses recommended are White Orpington-Sussex, and Sussex-Faverolles; these birds are large, easy to rear, and are suitable for the early chicken trade.

The stock are bred throughout the year, autumn and winter birds being hatched artificially, and the spring and summer lots under natural conditions.

Fowls are fattened, killed and trussed on the farm so that all the various branches of poultry keeping can be studied.

Experiments on caponising and breeding have been carried out, the results of which have already been made known.

FORESTRY.

Half an acre of coppice below the Hop Garden, planted with Oak and Chestnut, has been gapped up this winter with plants from the nursery, and another half acre has been cleared preparatory to planting with Ash pure next winter.

The Spruce pine plantation at the bottom of Field A has been gapped up with transplants from the nursery. Two-year and one-year plants were used, planted 4 feet apart each way.

In the small nursery near the hop garden are several thousand Oak, Ash, Chestnut, Corsican Pine Seedlings, Scotch and Spruce Pines, which are to be planted out during next winter. A small quantity of *Pinus Gerardiana* Wall Seeds has been sown.

AN EXPERIMENT ON THE EFFECT OF FOODSTUFFS ON THE PRODUCTION OF MILK.

BY V. S. RAWSON AND W. R. TUCKER.

An experiment was carried out on six Red Lincoln cows (some of which had newly calved), to find the effect of certain foodstuffs on milk production.

Each cow had the same basal ration, which consisted of

56 lbs. Roots.

4 lbs. Wheat Chaff.

3 lbs. Bran.

14 lbs. Long Hay.

and in addition one lot received seven pounds of maize meal, and the other lot received seven pounds of cotton meal.

The food was given as follows, four times per day.

5.30 A.M.	7 A.M.	3 P.M.	4.30 P.M.
22-lbs. whole roots	6-lbs. cut roots.	22-lbs. whole roots.	6-lbs. cut roots.
	1½-lbs. bran.		1½-lbs. bran.
	2-lbs. wheat chaff.		2-lbs. wheat chaff.
	3½-lbs. maize or cotton meal.		3½-lbs. maize or cotton meal.

The cows received their hay at 8 p.m.; when the animals were turned out to grass the amount of hay was decreased. The milkings took place at 5.30 a.m. and 3.30 p.m. The experiment lasted from April 26th until June 8th. The milk was analysed every morning and evening by the Gerber method, to find the percentage of butter fat.

The cows were numbered 11, 13, 15, and 1, 14, 18, the first three receiving maize meal, and the latter three cotton meal.

The weekly percentages of butter fat, and the quantity of milk per week of each cow are given below :—

MAIZE.

			1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.	Total average.
No. 11.									
Morning	..	..	3.1	3.1	2.6	2.7	2.45	2.6	2.75
Evening	..	..	4.45	4.35	4.3	4.2	4.05	4.0	4.15
Whole day	..	..	3.8	3.7	3.45	3.45	3.25	3.3	3.45
No. 13.									
Morning	..	..	2.7	2.8	2.95	2.75	2.45	2.7	2.7
Evening	..	..	3.9	4.0	3.95	3.9	3.8	3.85	3.9
Whole day	..	..	3.3	3.4	3.45	3.35	3.15	3.25	3.3
No. 15.									
Morning	..	..	3.1	3.2	3.2	3.1	2.8	2.95	3.05
Evening	..	..	3.55	3.6	3.75	4.0	3.6	3.4	3.7
Whole day	..	..	3.35	3.4	3.5	3.55	3.2	3.15	3.35

COTTON.

No. 1.									
Morning	..	..	3.3	3.1	3.05	2.8	2.8	2.85	3.0
Evening	..	..	4.4	4.2	4.3	4.4	4.35	3.7	4.25
Whole day	..	..	3.85	3.65	3.7	3.6	3.55	3.75	3.6

COTTON—*Continued.*

			1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.	Total average.
No. 14.									
Morning	..	..	3.95	3.2	3.0	2.85	2.95	2.9	3.15
Evening	..	..	3.2	3.3	3.6	3.25	3.2	3.55	3.3
Whole day	..	..	3.6	3.25	3.3	3.05	3.1	3.2	3.2
No. 18.									
Morning	..	..	3.2	2.9	2.7	2.6	2.65	2.45	2.75
Evening	..	..	3.7	3.4	3.55	3.2	3.4	3.1	3.4
Whole day	..	..	3.45	3.15	3.1	2.9	3.0	2.75	3.05

The figures bring out the well-known fact that the butter fat is greater in the evening than in the morning by about 1 per cent, due to the length of time between milkings.

It will be observed that there is practically no change in the percentage of fat. One of the maize-fed cows showed a slight falling off, but the difference was only small. In the case of cotton meal fed cows there was no appreciable drop or rise.

In all cases except in the case of cow 15, the percentage of butter fat decreased slowly during the whole of the experiment, and in cow 15 the percentage of butter fat also decreased towards the end of the experiment. The cows, as before stated, were at different periods from the date of calving.

We will now examine the total production of milk per week and average per day.

AVERAGE PER DAY IN PRELIMINARY TEST.

Cow No. 11 — 38 lbs. per day.

„ „ 13 — $40\frac{3}{4}$ „ „

„ „ 15 — $36\frac{1}{4}$ „ „

„ „ 1 — $46\frac{1}{2}$ „ „

„ „ 14 — $35\frac{1}{4}$ „ „

„ „ 18 — $33\frac{1}{4}$ „ „

MAIZE FED COWS.

	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.	Total.
Cow 11.							
Total	274 $\frac{1}{4}$	266 $\frac{1}{2}$	282 $\frac{1}{2}$	268	275 $\frac{3}{4}$	268 $\frac{1}{2}$	1635 $\frac{1}{2}$
Average per day ..	39 $\frac{1}{4}$	38	40 $\frac{1}{4}$	38 $\frac{1}{4}$	39 $\frac{1}{4}$	38 $\frac{1}{4}$	38 $\frac{3}{4}$
Cow 13.							
Total	272	274 $\frac{1}{4}$	287 $\frac{1}{2}$	268 $\frac{1}{2}$	276 $\frac{3}{4}$	261 $\frac{3}{4}$	1640 $\frac{3}{4}$
Average per day ..	38 $\frac{1}{4}$	39 $\frac{1}{4}$	41	38 $\frac{1}{4}$	39	37 $\frac{1}{2}$	39
Cow 15.							
Total	257 $\frac{1}{2}$	265	266 $\frac{1}{2}$	262	253 $\frac{3}{4}$	245 $\frac{1}{4}$	1550
Average per day ..	36 $\frac{3}{4}$	38	38	37 $\frac{1}{2}$	36 $\frac{1}{4}$	35	36 $\frac{3}{4}$
Cows 11, 13, 15.							
Average per day ..	38	38 $\frac{1}{4}$	39 $\frac{3}{4}$	38	38	37	38 $\frac{1}{8}$

COTTON FED COWS.

Cow 1.							
Total	301	298 $\frac{3}{4}$	307	304	272 $\frac{1}{4}$	263 $\frac{1}{2}$	1746 $\frac{1}{2}$
Average per day ..	43	42 $\frac{3}{4}$	43 $\frac{3}{4}$	43 $\frac{1}{4}$	39	37 $\frac{3}{4}$	41 $\frac{1}{2}$
Cow 14.							
Total	225	232	231	233 $\frac{1}{4}$	231 $\frac{1}{2}$	237 $\frac{1}{4}$	1390
Average per day ..	32 $\frac{1}{4}$	33 $\frac{1}{4}$	33	33 $\frac{1}{4}$	33	34	33
Cow 18.							
Total	212 $\frac{1}{2}$	209 $\frac{1}{4}$	220 $\frac{1}{2}$	202 $\frac{3}{4}$	198 $\frac{1}{4}$	204	1247 $\frac{1}{4}$
Average per day ..	30 $\frac{1}{4}$	29 $\frac{3}{4}$	31 $\frac{1}{2}$	29	28	29 $\frac{1}{4}$	29 $\frac{1}{4}$
Cows 1, 14, 18.							
Average per day ..	35	35	36	35	33 $\frac{1}{3}$	33 $\frac{2}{3}$	34 $\frac{1}{3}$

The average weight of butter fat was as follows :—

<i>Maize fed cows.</i> —No.	11—1.3-lbs.	}	1.27-lbs.
„	13—1.28-lbs.		
„	15—1.23-lbs.		
<i>Cotton fed cows.</i> —„	1—1.50-lbs.	}	1.15-lbs.
„	14—1.05-lbs.		
„	18—0.90-lbs.		

The figures vary very little, and seem to continue about the same throughout the whole experiment, if anything there is a slight decrease, but they are substantially the same.

It would appear therefore that where cows are already on a liberal ration the feeding of a large quantity of maize or cotton meal does not have any direct effect on the milk production. The albuminoid ratio in the case of maize meal is as 1 : 9.75, and in cotton meal as 1 : 2.1, and yet there is practically no difference in their effect on milk production.

It is of course realised that the experiment is not free from errors. The number of cows was too small—no trial with half-a-dozen cows can give any definite result—moreover, the cows were at different periods of lactation, the dates since calving not being the same for all. But the conclusion drawn above appears to be quite sound, and the interesting point is raised whether the heavy rations fed to dairy cows are always profitable, and whether the heavy food supply is always compensated by an increased milk yield. The application of the principle would vary in different districts depending on the price of food and of milk, but there must come a point everywhere where the increase in the food no longer pays for itself ; and only by feeding up to but not beyond this point can the maximum profit be secured.

REPORT
ON
ECONOMIC ZOOLOGY
FOR THE
YEAR ENDING APRIL 1ST, 1907.

BY
FRED. V. THEOBALD, M.A.

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INTRODUCTORY NOTE.

During the past year ending April 1st, 1907, 2,700 communications have been received.

A large number of these were concerning common pests. Very many letters were concerned with the spraying and washing of fruit trees, a subject about which we know very little at present. Washes innumerable are being put forward in ways that can scarcely recommend themselves to practical men. Some of them to my knowledge are more harmful than any insects are to the trees. Would it not be best for growers themselves to try these and see the results before they take any serious account of them?

The more interesting features only brought to light by the correspondents are published in this Report.

A full account of the life-history of some insects worked out during the past year are added, and also a general paper on the Woolly Aphis, owing to its recent increase and the large number of inquiries sent regarding it.

Amongst the most interesting attacks during the past summer have been those caused by a new Gooseberry Cecid in Herefordshire, the Leaf Hoppers or *Typhlocybidæ* in Worcestershire and Kent, the Black Currant Mite on Red Currants in Kent, the Eelworm damage in all parts of Britain, especially in Strawberries, Tomatoes and Wheat, the Pigmy Mangold Beetle in Herefordshire, and the Turnip Gall Weevil in the Hundred of Hoo.

The Leaf-hoppers or *Typhlocybidæ* have been dealt with more fully in a paper in the Journal of Economic Biology.

Some interesting new facts have been discovered in connection with the Wheat Midges, causing "Red Gum" disease, which will be published in detail later.

Numerous experiments have been carried out with various washes, partly in conjunction with Mr. Spencer Pickering, who has kindly supplied the various washes that he has worked with.

Experiments now running over some thirteen years have been

continued in connection with the eradication of Big Bud in Black Currants ; nothing has yet been found to have any definite effect.

Similar unsatisfactory results have to be recorded concerning the destruction of insect eggs in winter, but the large series of experiments being carried out in Worcestershire under the auspices of the County Council by Mr. Kenneth Furley, and the similar ones being carried out by many growers in Kent and Surrey may yield some definite results. The greatest success so far has been attained by the use of lime and salt as recorded in this Report, but the matter requires further work yet to find out what is best to add so as to increase its adhesive power. A detailed report on this will be issued later.

A large number of communications have come from Africa and other parts of the Empire which are not mentioned here. The various reports sent to the Department of Agriculture of the East Africa and Uganda Protectorates are in the hands of the Colonial Office for separate publication.

A Report of investigations on Bees and Clover Fertilisation was drawn up by Mr. C. W. Mason and sent as requested to the Department of Agriculture of New Zealand. A short notice on this subject is appended.

A paper on the Strawberry Anthonomus (*Anthonomus rubi*) by Mr. Fenoulhet is also included.

My thanks must be expressed to the following gentlemen for their kindness in identifying obscure insects, worms, etc., Professor Nalepa, of Vienna ; Dr. L. O. Howard, of Washington ; Professor Railliet, of Paris ; Mr. C. O. Waterhouse, Sir George Hampson, and Mr. Kirby, of the British Museum ; Mr. Robert Newstead, of Liverpool University ; Colonel Bingham, Mr. Distant, and Mr. Warburton.

A large amount of invaluable help has been given me by Mr. S. Rothwell in connection with various investigations, and also by Dr. Russell and the staff of the Chemical Laboratory.

The Photographs have been taken by Mr. Rintoul and Mr. Edenden. The following taken by Mr. Rintoul are his copyright : Plates v. vii., x., xii., xiii. and xvii. Figs. 2, 3, and 8 are from Reports of the U.S. of America Department of Agriculture.

F.V.T.

ANIMALS INJURIOUS TO MAN'S DOMESTICATED ANIMALS.

Red Worms (*Sclerostomum* spp.) in Horses.

A request was sent from Ecclefechan, Dumfriesshire, in August, concerning an attack of Red Worms in horses. A number of animals had been lost at the age of about a year and a half old. The correspondent, whose stock was infested, was advised to use the Thymol remedy, advocated by Miss Dillon and myself through Monsieur Blanc, the well-known doctor in South France. So far, this substance used for vermiceous pests has proved as beneficial in horses as in human beings. The red-worms or sclerostomes of the horse are of three kinds as has been previously mentioned in the Journal of the S.E. Agricultural College (No. 6, pp. 3-9, 1897), namely, *Sclerostomum equinum* Muller; *S. tetracanthum* Diesing; and *S. rubrum* Theobald.

The difference in the life history between the first and last is very marked, and probably *S. tetracanthum* is similar to that of *S. rubrum*.

The first-named is known to invade the blood vessels, especially the branches of the dorsal aorta, and to cause a thrombus which may lead to the bursting of the vessel, and so cause hæmorrhage.

The other two species do not enter the vascular system, but live in the mucous lining of the caecum and colon, where they produce small tumorous looking lumps from which they later on escape, and then live freely in the intestinal contents and become sexually mature.

In their early stages, as when found in the mucous membrane of the caecum and colon they are almost white, but when free in the gut they become pink or almost red.

The large armed sclerostome (*Sclerostomum equinum*) is also red when mature, but of a browner or grey tinge. Moreover, it is very much larger, often reaching as much as two inches in length, but mature females may be found only an inch long. The others seldom reach more than two-thirds of an inch: the males being sometimes as small as one-third of an inch.

The spined sclerostome, *S. tetracanthum* of Diesing, is described as being white and can at once be told by the two lateral spines placed cephalad; the *S. rubrum* Theobald, which seems to be the common British species, is reddish or pink, and has no lateral spines.

In the last named species development has been shown to be direct; that is a horse taking the ova in water or forage may become infested. Judging from the numbers found in certain animals, there is no doubt that breeding takes place in the intestines, and that the embryos coming from the ova reinfect the mucous membrane, otherwise we cannot account for the thousands that frequently occur in the same animal.

Numbers of the eggs are also carried out in the horse's dung, and get distributed about on the land and get into water. In this way other horses become infected by both ova and embryos, for it has been found that the ova may hatch on the earth. It is interesting to note that several outbreaks of these parasites have spread down stream. There is no doubt that the ova get carried by water and thus the disease which frequently takes an epizootic form is mainly spread.

The serious nature of these parasites, and the great loss they have occasioned in parts of England and Wales is too well known. I have not heard before, however, of an outbreak in Scotland, and the matter is thus particularly interesting.

The worms, of course, are easily distributed, and as there are no diagnostic characters in incipient or slight attacks, no steps can ever be taken to check the spread. Treatment, however, by Thymol is now so well known, and found so successful for horses that the virulence of the parasites loses much of its power.

PLATE I.



A FOWL MITE (*Megninia cubitalis* Megnin).
(C. A. Armstrong.)

A New British Strongyle in Sheep.

Mr. Cave gave me some Strongylidae which had been found in abundance in the stomach of sheep affected with anæmia.

These were sent to Professor Railliet, of Paris, as they could not be identified, and he pronounced them to be the *Strongylus ostertagi* of Ostertag. This worm so far has not been recorded as British.

Lice (*Mallophaga*) in Poultry.

A fowl sent for post-mortem from Brasted, in August, was found to be covered with lice. Four days before she died she would not take any food ; she gradually wasted away and died. Lice belonging to the so-called *Mallophaga*, insects of the order Neuroptera are only too harmful to old and young poultry, and it is not at all unusual for chicks and turkey poultts to succumb to their attacks.

The above case is recorded as actual death caused by pruritus in mature birds is of somewhat unusual occurrence. The organs of the bird were quite normal and healthy, but it was simply alive with *Menopon biseriatum*, and a few other species. Yet the fowls seem to have been kept in quite clean and healthy surroundings. There is no doubt that certain birds are more predisposed to the attack of lice than others, even in a healthy state. The lice produce a weakened condition, and this renders the fowls more susceptible to such diseases as tuberculosis, diphtheria, cholera, etc.

The Fowl Acarus (*Megninia cubitalis* Megnin).

Mr. C. Alan Armstrong, writing in connection with the new British Fowl Acarus, *Megninia cubitalis* Megnin, recorded in the last Report, p. 12, further mentions that it was obtained in the mouth of a dead chick and also from a small white cyst on connective tissue of another bird.

Its extremely small size, and its transparent nature, probably accounts for its not having been previously recorded from the British Isles.

A photo is reproduced here of *Megninia cubitalis*, which has not since been recorded. (Plate I.)

The Mange Mite (*Sarcoptes scabiei-var-equi*) of the Horse.

An inquiry and specimens of this mite were received from Huntingdonshire in June.

It is far from uncommon on horses and all solipeds, and is the cause of so-called "itch" or "mange." It is one of the largest *Sarcoptes*; the ovigerous female measuring up to .5 mm. and the male .30 mm.

These *Sarcopt* mites form sub-epidermic galleries, and in these tunnels they deposit their eggs. Different stages are seen in the photograph taken from specimens sent. (Plate II.)

This species is figured because it is sometimes thought by owners that "lousiness" is the same disease. The Horse Louse (*Haematopinus macrocephalus* Burns.), is quite a different animal.

A smaller louse, *Trichodectes pilosus* Giebel, also occurs on horses in this country. A full account of this mite is given in Neumann's "Parasitic Diseases of Domesticated Animals," p. 186 (1892).

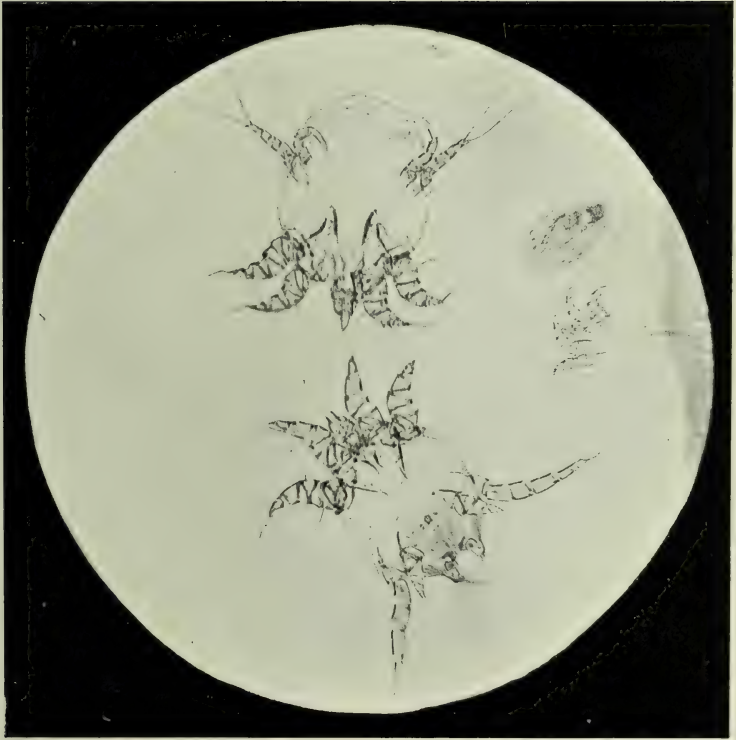
The Foot Scab-Mite of Sheep (*Symbiotes communis var. ovis*, Railliet).

This acarus which Professor Cave referred to in the *Journal* of the College for last year (No. 15, p. 244, 1906), has been found again on a sheep in North Devon. Besides the reference of its occurrence in Huntingdonshire in 1900 and Professor Cave's notice from Kent, it has not been further recorded.

Symbiotes communis v. ovis of Railliet, is very like the variety found on the horse (*var. equi*), but can at once be told by the fourth pair of legs being much slenderer in the male, slightly slenderer in the female. The terminal bristles on the third pair of legs of the female are also longer and more unequal in length.

The photograph reproduced here was taken from specimens received by Professor Cave, the reader being referred to his note in the *Journal* for further information. (*Vide* Plate III.)

PLATE II.



THE MANGE MITE OF THE HORSE (*Sarcoptes scabiei-var-equi*).
Male, female, larva and ovum.

PLATE III.



THE FOOT SCAB MITE OF SHEEP (*Symbiotes communis v. ovis*).

A Wash to Protect Cattle and Horses from Flies.

Mr. C. A. Boughton Knight, of Christchurch, Hampshire, wrote in May asking for some method of keeping flies, etc., off cattle and horses, which were so annoying in that district.

This request is one that too often comes from all parts of the world, for unfortunately, we have at present no substance known that has any lasting effect.

Where flies are so annoying to animals, especially for the all-important transport in warm climates, this is of far more importance than here, but so far nothing has been found to be of a durable nature.

For cattle some good may be done by smearing them with any noxious greasy substance. MacDougall's Smears are excellent for this purpose.

Biting flies or gad flies (*Tabanidae*) are kept at bay sometimes by the mere decoration of the horses with bruised walnut leaves, but it seems that where numbers occur this fails and they ignore the acrid smell in their lust for blood.

Horses may be protected for a few hours by rubbing a paraffin rag over them, a very advisable thing to do in the New Forest, for a horse fresh in the locality when being driven, for *pro tem.* this undoubtedly keeps off those pertinacious and annoying Forest Flies (*Hippobosca equina*). But to do this for horses turned out to grass would be mere waste of time.

For animals at large the only thing we can do is to give them some place of shelter during the hot part of the day, any rough shanty or hovel will suffice, for anyway Gad Flies (*Tabanidae*), and Warble Flies (*Oestridae*), which will not enter the shade. Storm Flies (*Stomoxys*) will, however, and under certain climatic conditions, they cause much inconvenience to animals, and much pain.

All that can be done is to use some dressing, such as has been mentioned, or make a thick smear of cart grease or tar with some dilute carbolic.

It may be mentioned here that to smear the backs of cattle to protect them from *Warble Fly* as recommended by Miss Ormerod, is waste of money in many parts of this country. The common English Warble Fly is *Hypoderma lineata*, which lays its eggs on the

legs of cattle. The Ox Warble Fly (*H. bovis*) mentioned by Miss Ormerod, is comparatively rare in England, but even this probably lays its eggs in the same position and not on the back as supposed. In any case it has not been seen to do so, and all evidence is against it.

Hypoderma bovis occurs in some numbers in Ireland.

ANIMALS INJURIOUS TO FRUIT TREES AND BUSHES.

A.—TO APPLE.

The Fruit Bark Beetle (*Scolytus rugulosus* Ratze.).

The damage caused by this Bark Beetle seems to be on the increase. It has been sent from Devon, Worcester and Kent. Writing in July, Mr. Lewis Levy, of Borden Hall, near Sittingbourne, says, "We have a plum tree which has just died, and find numerous tunnels between the bark and the wood, and also in the latter." The specimen sent and the damaged wood, proved the culprit to be *Scolytus rugulosus*. Numerous trees were observed in Worcestershire, several of which had been killed, and others were dying from the effects of this Bark Beetle.

Specimens of damage were also received from North Devon.

The worst attacked specimen seen was sent me by Mr. Gardner, of Ombersley, who very wisely destroyed the infested trees.

The beetle has somewhat varied food. It seems to have, however, a decided preference for plum and then apple. I have seen pears similarly attacked, but never cherries.

The Board Leaflet (No. 49), says also peach, apricot, nectarine and quince. In some cases it seems that the beetles prefer to oviposit in the smaller branches and twigs, which thus wither and die.

The leaves soon show signs of their presence by wilting, dying later and turning brown. The bark then cracks and eventually peels off.

Most cases recorded and seen during the past year have been attacks on the stems of trees from eight to fifteen years old. In one case the whole stem from five feet above the ground into the branches, was riddled with shot holes—the “flight-holes” of the beetles.

Whilst on the smaller boughs and twigs, the bark readily cracks and splits off, that on the stem was noticed to remain in its normal position.

On removing the bark one finds that the shot-holes lead down through it to the wood, in the soft sappy layer of which the larval scolyti have been working and sculpturing galleries, which run mainly up and down between the bark and wood. From these median channels run on either side smaller ones, in which the larvae live.

There is a popular idea that only sickly or unhealthy trees are attacked. That they are so more than others is very probable, but perfectly sound trees suffer in the same way.

The mere fact that we find larvae and pupae in the dying and dead wood does not necessarily show that the beetle only attacks such wood. The larvae have caused the unhealthy state or have killed the tree themselves, and have to finish their development where they have lived.

From various observations made, it appears that when once a tree is invaded it forms a centre that attracts the beetles to oviposit and thus if we only destroy it at the right time we can use these damaged trees as “trap trees” are used in forestry. Both old and young trees suffer. In an old orchard where trees have never been tended, it is no unusual thing to see many of the smaller branches and twigs bared of bark and showing up pale against the rest of the wood. This is usually due to this beetle.

From these old neglected trees they invade young and sound ones.

Life-history.

The beetle that is the cause of this damage is quite small, often no more than one-tenth of an inch. In colour it is nearly

black, with somewhat brown elytra, legs and clubbed antennae. The thorax is finely punctate, and the elytra have lines of punctate striae.

The beetles are said to appear in April and May. They certainly more usually occur in June in Kent, and again in October, for specimens were bred out from the wood sent by Mr. Lewis Levy in early October, and some a little later were sent me by Mr. Furley, from Worcestershire.

They are also said to occur in June and July.

It thus looks as if we had three, not two broods, during the year.

The past year's experience shows that we have them, anyway, in May, early June and October.

As a number of specimens also escaped from material sent me in July, we may safely assume that three broods do occur.

The beetles bore into the wood to deposit their eggs: those under observation tunnelled upwards along the bark a little way, and then into the bark. They then formed a tunnel often nearly an inch long, between the bark and the wood, the sculpturing being more pronounced on the latter than the former. These so-called "mother-galleries" are almost straight, and pass up the tree and along their sides the female lays her eggs. The length of the egg stage has not been followed, but in a few days small white footless larvae appear, and tunnel roughly at right angles to the parent gallery. When mature the larvae pupate at the end of their galleries often forming a deepened chamber into the wood. The beetles then escape through the bark, and leave behind the innumerable small shotholes.

There have been counted some fifty larvae coming from one "parent-gallery"; how many may occur is not known.

The winter seems to be passed mainly in the larval stage under the bark of the trees, and thus damage is done during the whole year.

Treatment.

Nothing can be done to trees badly attacked. They had best be left as "traps," and cut down and burned during the winter, or at any time when we know the beetles are not in flight.

This must be done not later than the first week in June, and is best done in May, when no beetles have escaped as far as personal observations go. If the destruction at the time all the insects were in the trees was carried out, the loss these little beetles occasion would be much lessened. It is especially important to have old stumps, dying trees, etc., destroyed. Great numbers of these were noticed during the past year in Worcestershire, and as long as they remain in this useless, slovenly way, so long will young, sound trees, of good fruit growers in the neighbourhood be damaged, for in flight time these beetles are very strong on the wing, and can fly considerable distances, judging from their vivacity.

The dressing of fruit trees to keep off this pest has been frequently referred to in this country. It is almost a useless task unless we have a very widespread attack, and then it may ameliorate it to some extent.

Dr. Saunders mentions that in Canada the trees are dressed with soft soap and washing soda up to the point where the main branches have their origin.

In this country it is the small branches and twigs that are attacked as much as the trunk, and thus dressing is of no value—it *will* protect the trunk, but merely drives the beetles higher up, and dressing the whole of a large tree, of course, is impracticable.

There need be no great harm done if the diseased trees are destroyed at once to stop the beetles from spreading, and if some persuasive steps could be taken to get negligent people to destroy the old breeding grounds of this beetle. A pig with swine fever is killed by compulsion, but it does not seem worth while to compel breeding grounds of fruit pests to be destroyed. So long as the many fruit growers who excell those of any other country, allow this to go on, so long will they lose trees by this and other pests, and their energies and money will be largely wasted.

Apple Clearwing (*Aegeria myopaeformis* Bk.).

On the 21st of June, larvae and pupae of this Clearwing Moth were sent from the Croydon district by the Secretary of the Horticultural Mutual Improvement Society.

The larvae were taken out of an apple tree, Warner's King, where they had been working havoc underneath the bark, in patches. In many instances it was recorded as being found in the wounds caused by Woolly Aphis.

"The attacked trees are about six years old," writes the Secretary, Mr. Boshier, "and are in good bearing condition."

On June 26th, a further lot of pupae were sent, taken from Duchess Favourite, Warner's King, Colonel Vaughan and Winter Queening. The larvae were mostly found about seven feet from the soil. The Clearwing Moth is somewhat similar to the Currant Clearwing in general appearance, but can at once be told by the broad red belt on the abdomen. The size is about 20 mm. with a wing expanse of 22 to 25 mm. The head, thorax and body are black, the latter has a bright red band above, white beneath in the male, in the female the underside is only edged with white; the tail fan is black. The wings are transparent, with dark scaled areas. The moths fly by day, and are found in May, June and July.

They frequent gardens and orchards, and lay their eggs almost exclusively on apple trees.

Wood, in his *British Moths*, says they are "said to feed on the small stems and twigs of the apple tree."

This does not appear to be the case for the trunk only seems to be attacked as described at Croydon.

The moth lays its eggs on the trunk of the tree, and the larvae tunnel under the bark; there they work until they are mature, and then eat out a hollow in the wood, which they line with silk of a dull grey colour, and cover the outside with brown wood chips.

The larva is dull yellowish-white. Buckler describes a pinkish pulsating dorsal vessel, with an internal purplish-pink tinge from segments five to eight; this could not be detected in the specimens sent me. The head is retractile and shiny reddish-brown; the second segment is somewhat wider than the others, and has a dorsal brown shield; the segments are very distinct, and the prolegs small, very inconspicuous; there are traces of spots each terminated by a bristle. The specimens sent were mature, and measured a little more than three-fifths of an inch in length. The whole larva seems rather flattened. The mature larvae are very sluggish

when extracted from their irregular burrows, and had all pupated by June 29th.

Many had pupated before I received them on the 21st.

The pupa is bright pale brown, and lies completely protected in its silken case covered with rich brown wood chips, and apparently some "frass" from the larval workings. In length the pupae varied from a little over one-third to nearly one-half of an inch.

They were all curved, and slender and tapered to a point at the apex, which is bluntly rounded with a ring of spines; the first five abdominal rings have two dorsal rows of spines, the two following, one each. The spines are somewhat darker than the ground colour.

When ready to hatch, the pupae make their way partly out of the cocoon, and the empty brown skins are seen protruding from the trees.

Treatment

can only be of a very doubtful benefit, as the larvae are difficult to get at, but it is said that a sticky dressing easily checks the egress of the moths, and prevents further egg laying.

The Gold Tail Moth (*Porthesia auriflua* Fabr.).

The life-history of this common moth does not seem to be generally known in this country.

It is often very harmful, not only to hawthorn hedges, but also to fruit trees throughout the country at certain times.

The moth is now referred to chiefly on account of a method by which the insect may be checked having been found during the past year. In connection with the destruction of Codling Maggot, Mr. H. J. Small, of Evesham, was advised to apply the sack-banding found so beneficial in stamping out the Codling Moth in orchards and gardens. Under these bands were found numbers of Gold Tail larvae during the winter, snugly ensconced in their little winter cocoons.

It thus seems probable that this plan of trapping Codling Moth may also mean saving the loss of foliage due to the Gold Tail Moth.

This beautiful moth, with pure satiny white wings, is found in its mature stage settled with its wings folded downwards on leaves, palings, lamps, etc., in August. In the male is noticeable a dusky spot on the inner border of the forewings. Thorax and abdomen are pure white, but the latter has a golden yellow tail tuft. In size the male varies from an inch to an inch and a quarter, the female up to an inch and three quarters.

Life-history.

The life-history may briefly be referred to as follows :—The moths lay their eggs in August on apple, plum, pear, hawthorn, hazel, cob, oaks, roses and other trees. The eggs are laid in golden coloured nests of hairs, derived from the female “tail.” They hatch in some seven to ten days, and the small larvae feed upon the leaves until the autumn, during this time they moult once (Taschenberg says twice).

As soon as the leaves harden, these little caterpillars at once go into winter quarters. They seek out shelter in bark crevices, under the bark scales, under moss and lichens, and in various holes. Here they spin small dull grey cocoons about one-fourth of an inch in length, and remain hibernating during the winter. Although they appear to be solitary, yet numbers will go to any suitable place of shelter, and hence we find that the sacking used to catch Codling Maggots also attracts them, as shown by Mr. Small. These winter cocoons are very delicate, and contain the larva curled up within.

In spring they come forth as soon as the buds swell, and commence to feed on the young leaves. Those sent from Evesham came out of their small cocoons on March 18th. They continue feeding until July, but many mature in the latter part of June.

The larva is deep brownish-black, with a bright red dorsal stripe, a red line on each side spotted with white, and another above the legs.

The segments have tufts of brown hairs.

When mature it spins up in a grey cocoon with larval hairs in its meshes, and changes to a deep brown pupa ; these are usually formed at or near the food plants, sometimes between leaves, at others on the bark or between the forks, or on palings, etc., near by.

There seems something wrong with the account of this insect given in the English translation of Kollar's "Treatise on Insects Injurious to Farmers," etc., by J. and M. Loudon, for on page 199 they speak of *P. auriflua* as the Brown Tail Moth, and on page 190 *P. chrysorrhoea* is put as the Gold Tail.

The popular names are most appropriate if rightly applied, and this error is pointed out in case that interesting little German work falls into the hands of those who are not fully acquainted with the insect's economy.

There is no doubt that the note given on page 199, describing the great abundance of *Porthesia auriflua* in 1782 in many parishes near London, in some to such an extent that "Prayers were offered up in some of the churches to deliver the country from the apprehended approaching calamity" really refers to the True Brown Tail (*Porthesia chrysorrhoea*), for poor people are mentioned as being employed to cut off the webs at a shilling per bushel. The Gold Tail does not form a web at all, the larvae feed solitarily, but the Brown Tail (*P. chrysorrhoea*) does.

That it is of frequent annoyance we know, but the damage done when the larvae are large is comparatively slight, compared with the little known harm caused by it in the young stage in the spring, which we can easily check.

Treatment.

This consists of catching the larvae by enticing them to some comfortable winter quarters, such as has been found in the banding adopted for Codling Moth prevention mentioned on the previous page. These bands and the collected larval cocoons can be burnt in winter with the Codling Maggots caught by them. The caterpillars, when appearing in any numbers later in the year, can be killed very readily by spraying with arsenate of lead, which has been found much more effective than Paris Green for this species.

The only bird that feeds upon these larvae is the cuckoo.

The Brown Tail Moth (*Porthesia chrysorrhœa* Linn.).

This moth which was so abundant in East Kent in 1900 and 1901 has only once been recorded since, until this year when Mr.

Wright brought me a winter tent sent him from near Hythe, and another was received from near Ashford. The rapidity with which it died out was partly due to some parasitic flies (*Thelymorpha vertiginosa* Fl.) which I bred out in great numbers in 1901. A full account of this moth was sent to the Board of Agriculture Journal (September, 1901, p. 194), and was issued in leaflet form in 1901, and in revised form in 1903 (Leaflet No. 69).

The Lackey Moth (*Clissiocampa neustria* Linn.).

This bombycid moth still seems to be causing some harm, for during the past year it has been notified from Teynham by Lt.-Col. Honeyball, from Boughton by Mr. Berry, from Lynton, North Devon, from Nottinghamshire, from Somerset, and from Hampshire.

The life-history of this pest is so well known that it need not be referred to here.

In young trees that are annually pruned, if the *prunings are burnt*, the Lackey Moth can be easily kept down, for according to Mr. Berry, they lay their egg-rings on the last year's wood, and thus most get destroyed. But on old trees this is not the case, and as a result we frequently get great numbers of tents noticeable in the summer.

It is important to notice these "egg-rings," so that they may be destroyed in the winter.

I have still no record of this moth as being a pest north of Yorkshire, and only a few times from as far north as that. The south-eastern, southern and western counties seem to be its main abode.

The Clouded Drab Moth (*Taeniocampa instabilis* Linn.).

The caterpillar of this moth was reported by Mr. Getting to be attacking his apples near Ross. In his note he says, "It is astonishing what holes the caterpillar can eat in the fruit."

Later, Mr. Getting wrote me that he had only found the two actual caterpillars sent me, but that he had come across a good few suspiciously eaten apples. "The first I sent I found actually eating the apple."

The normal food plants of the caterpillars of the Clouded Drab Moth (*Taeniocampa instabilis*) are sloe, willow and oak. The moth is pale leaden grey, with three thin darker, wavy transverse lines, and a broad dark area between the second and third thin lines; the hind wings are unicolorous, but the veins show up darkly; the hairy thorax is the same colour as the fore wings, and the broad hairy body is paler than the thorax. In colour, however, there is some variation, for it is not infrequent to find dull reddish-brown specimens. The wing expanse varies from one and a quarter to one and a half inches.

Like most of this group, it occurs freely at sallow blossom in the spring, and may be easily collected at dusk by shaking the blossoms over an opened umbrella. They occur on the wing in March and April, and a few straggle on into May.

The caterpillar is green, dotted with black, with a dorsal yellowish green line and two lateral lines of the same colour. They may be found in May, June, and just into July, and normally feed on the leaves; the habit of eating the fruit and occurring on apples appears to be abnormal. When mature they reached an inch and a quarter in length, and then pupated in the soil. They are said to form a loose cocoon of particles of earth, but the ones sent by Mr. Getting changed to deep rich brown pupae nakedly in the breeding cage.

The moths hatched out in February owing to their having been kept in a warm laboratory.

This insect is common everywhere in this country.

The Pith Moth (*Blastodacna violentella* Herr Schäff).

This moth has been reported from several localities in Kent, notably Teynham by Lt.-Col. J. F. Honeyball, at Perry Court by Mr. Amos, at Woodnesboro' by Mr. Buley, and at Linton by Mr. C. Smith. In the latter place the Worcester Pearmain was attacked, but not the alternate rows of Lord Derby.

I failed to gain any information of it in the Western Counties, but Dr. Carpenter records it in his Report on the "Injurious Insects and other Animals observed in Ireland during the year 1905," p. 333,

PLATE IV.



Apple Shoots showing winter quarters of Pith Moth
with air hole.

from Donnybrook, near Dublin, and points out that the correct name is *Blastodacna vinolentella* Herr-Schäff and not *B. atra* Haworth.

The latter insect lives in hawthorn berries, and there is no doubt that the apple Pith Moth is distinct, as Professor Carpenter says, but the difference usually taken to separate these two insects, namely, the colour of the head, will not hold. It is said that the true *atra* is characterised by a white head, *vinolentella*, by a black one. I have bred white-headed forms from apple in numbers, and very few black.

There may be two or three species confused here.

It is not only the terminal shoots that are attacked, it is mainly the "spurs" that suffer.

The young larvae bore into the shoots and spurs in autumn and remain through the winter just under the rind. A blistered area is formed with a pronounced round hole on or near it as seen in the photo reproduced here. In early spring the caterpillars are to be found in the centre of the young shoots, and the small, round hole, through which the young larva has bored into the shoot can be distinguished, usually close to the origin of a bud.

In Kent and Sussex it is the spurs that are mainly infested, but now and again the shoots are killed.

I have a specimen all black bred out from the apple, which certainly answers to *vinolentella*, but which is not like the Pith Moth that I have recorded from Kent and Sussex, which usually have pale heads, now and then black but which differ in being smaller, and with more ornate wings.

The Apple Leaf-Blister Moth (*Ornix petiolella* Sta.).

Amongst several specimens of apple leaves sent during the past year damaged by mining larvae, one was found to be attacked by the little Tineid known as *Ornix petiolella*. The mine formed by this species is a rough blotch, like that of the nut species, and is on the upper surface of the leaf. The larva found in these blisters is greyish-green to olive green colour, the third to tenth segments have six pale spots, four in a row in front and two behind; from these arise short stiff hairs. In length, the larva may reach

7.5 mm. They are found in June, and again in September. When mature the larva leaves the blister and spins the two sides of the leaf together, which forms a nest over half an inch in length (Stainton says an inch); within this the larva, which finally assumes an orange yellow hue, spins a dull yellowish cocoon.

The moth first appears in May. Its wing expanse is from 10 to 12 mm. The front wings are deep brownish-grey; on the costa are seven or eight white patches, and on the inner edge also are some whitish markings; the fringe has two external thin black lines from the costa to the anal angle. Posterior wings, grey with long grey cilia. Thorax spotted white and grey. Abdomen deep grey, apex ochreous; legs, grey and white scaled.

The moths fly towards evening; very few were seen in May, but in the late summer the second brood was quite abundant in some trees. It does not, however, seem to do much harm.

The Wild Crab Leaf-Miner (*Nepticula malella* Sta.).

This small mining Tineid Moth was reported from Kent as being very abundant on apple trees in the autumn. In one case nearly every leaf was found to be mined in early October. Many of the leaves had fallen in the latter part of September owing to this little insect's depredations. At this time of year, the damage is, of course, not serious, but the loss must to some extent, check the final annual growth, in young trees especially.

The mine caused by the larva is very characteristic. It starts as a small, thin, sinuous tunnel, which gradually swells out into a blister-like area, at first green, and then becoming yellowish green.

Stainton, who gives an excellent account of this moth, describes the mine as greenish-orange. None were seen in which any orange tone appeared, but the identification is beyond doubt. One very noticeable feature is that the track of the larva is marked by a dark, sinuous line of black excrement.

As many as six mines were frequently seen on one leaf. All varieties seem to be affected, but Cox's Orange Pippin; no trace could be found on any of the latter although they were growing amongst attacked trees. The early maturing of the leaves may have something to do with this.

Should this moth continue in abundance in the following year after an autumnal attack, it might cause a good deal of harm, as the first brood attacks the leaves early in July.

The distribution is very wide in England, specimens having been received from Devonshire up to Yorkshire. I believe it occurs in Scotland, and Stainton records it from Dublin.

It is now just as mentioned by Stainton in 1855, very common in the London district. In 1887 it was quite harmful at Kingston-on-Thames.

Life-history.

The moth appears towards the end of May. The female places her eggs on the under side of the leaves, in most cases close to the mid rib, from which area the mine first commences. Now and again it is placed in other parts of the leaf. In colour, the moth has almost black anterior wings, with a bright pale (almost white), band across each on the apical half; the hind wings are grey and all the fringes. The thorax is dark, and the abdomen grey.

In length it reaches 4 to 5 mm.

The larval mine is at first very thin, and gradually increases in size, winding somewhat in conformity; suddenly it swells out into a more blister-like area of pale hue, the exact tract of the larva being marked by a dark line of "frass." The larva is pale amber-yellow, with a dark central line, sometimes brown, at others with a red tinge; the head is brown, and the body slightly hairy. When full fed it reaches about 4 mm., and then eats its way out of the leaves from the upper surface.

The free larvae seek shelter at the base of the leaves, in any crevice, or even fall on to the ground, and then spin an oblong oval cocoon of dull yellowish silk.

The second brood of moths appear in early August, but some years not until the middle of the month, and these produce the larvae which make the mines seen in September and October.

Last autumn the second brood of larvae had matured mostly by the second week in October, but a few were found in the leaves as late as November 4th.

They winter in the pupal stage in crevices on the trees, around the buds, etc., and in any convenient shelter.

It was said by Stainton to be common on the wild apples in the hedgerows. In this way invasion can always come to an orchard. Fortunately, wild apples are scarce. It has also been observed on the medlar and quince, but so far, not on hawthorn. A number of the larvae were found dead in the mines in the autumn. The cause of this could not be traced.

Treatment

for these Apple Leaf-Miners is somewhat difficult, but it is possible that a good dressing of lime wash would so coat the little cocoons that the early brood of moths could not escape from the cocoons.

In nurseries it is advisable to hand pick any mined leaves in July, before the escape of the larvae.

The Woolly Aphis (*Schizoneura lanigera* Hausmann).

The persistent increase of this Aphis during the last few years in most of the fruit centres of Britain makes it imperative that growers should take steps to check its increase in their plantations. Of still greater importance is it for nurserymen to see that the stock they send out is free from this insect. During the past year, communications have been sent me by several growers, stating that they have introduced this insect with purchased stock.

One correspondent, writing from Liscard, Cheshire, says, "I have been buying apple trees from various nurserymen, and have introduced American Blight into my orchards, and my gardeners do not seem to be able to check its progress."

No nurserymen of any standing would dream of sending out apple trees infested with this "blight." I have seen in many cases how carefully they go over the nurseries with hand labour, painting any patches with methylated spirit, and yet they send out infected stock. The reason is obvious: they either do not know or discard the presence of *Schizoneura lanigera* on the roots. The complete life-history of this apple enemy is well-known, but this knowledge is not sufficiently widespread to bear any fruitful results.

So numerous have been inquiries concerning this pest during the past year, that it is thought that a full account of its life-history

PLATE V.



A.



B.

[A. V. D. Rintoul.]

- A. Apple twig showing swollen areas on left caused by Woolly Aphis, which crack as seen on the right.
- B. Woolly Aphis working up a tree from roots, present on basal twigs and suckers.

may be of some service, together with an account of some recent experiments carried out in connection with its prevention and treatment.

The area over which it occurs may be but briefly mentioned; enough to say that wherever apples are grown, the blight also is found.

At one time it seemed to be mainly prevalent in the old west-country orchards, especially amongst the somewhat ill-kept cider apples. Now we find it just as bad in young plantations of the best varieties.

It is, perhaps, most abundant in Worcestershire, and in the Devon orchards, but in all other centres it is an important and increasing enemy. It has been reported to me, or observed in all parts of Kent. During the past year it was reported as being very bad in the Sevenoaks district; Mr. F. O. Walker says it is very bad at Ulcombe, and that nothing but scrubbing with a hard brush does any good.

It is most abundant in Surrey. A correspondent writing from Woking, states that he is much troubled with it, and that he had used lots of mixtures and kept brushing in summer, but without success. Numerous inquiries have come from Cambridgeshire, Huntingdonshire, Norfolk, Suffolk, Cheshire, Yorkshire, Sussex, Hampshire and Oxfordshire. In Wales I have found it in abundance amongst young trees imported from the Midlands at Criccieth, and at Carnarvon and Bangor; in Monmouthshire it was noticed in some gardens. This record of localities could be still further increased, but the main places of its occurrence are those mentioned above.

Besides being known under the popular name of Woolly Aphis, it is frequently spoken of as "American Blight." The reason for this is difficult to understand, for it is undoubtedly European, and we are also equally certain that it was introduced into America just as it has been into Africa and Australasia with imported stock.

It attacks practically all varieties of apples, but it is claimed that in Australia it will not attack the roots of apples grafted on stocks of the Northern Spy and the Majetin. This is a very important point, and one which wants further investigation. Neither of these stocks are used in this country. Nurserymen whom I have

spoken to about the subject have expressed their opinions adversely, but I am not aware that anyone has tried them in this country, and until this is done one must naturally believe not only what a great expert such as Mr. French, the Government Entomologist of Victoria, states to be a fact, but which fruit growers of very great skill have proved to be the case in Australia.

The mere presence on the trunk and boughs is nothing as long as we can prevent its occurrence below ground.

The damage caused by the Woolly Aphis is particularly severe to young stock, but old trees also suffer in two ways. Firstly the aphides lessen the vitality of the tree by constantly sucking out the sap ; secondly, by the wounds caused by their punctures on young wood, they cause an abnormal growth of soft tissue, which forms rounded swellings, so very characteristic of Woolly Aphis presence. These swellings split later on, and from them arise those large rugose deformities, so often put down to "canker." At the same time they cause similar damage on the roots, but the swollen gall-like growths that they produce do not necessarily split in the way we find above ground. In these two ways the life of the tree is gradually sapped, and not infrequently young trees die under this rough usage. In any case stunted deformed trees result, and but scanty and poor quality fruit is borne by the tree.

But there is a third way I feel certain in which this Woolly Aphis works injuriously. After keeping records during the past twenty years, I find that in nearly all cases trees infested with canker have or have had Woolly Aphis attacking them. During the summer of 1903 two trees (Worcester Pearmain and a Russet), which were perfectly clean, were infected with Woolly Aphis ; next year both were attacked by canker. One tree close to them not attacked by the *Schizoneura*, is still clean.

There is no doubt that indirectly this Aphis, by causing wounds of greater extent than any other species on the apple, predisposes the trees to the fungus enemy, for which we have no known remedy.

The importance of knowing the life-history is therefore very great, for it is only by so doing that we can learn how, when and where to apply any satisfactory treatment.

The effect of weather on this *Schizoneura* is nil. It will be just as bad in a wet, cold, as in a warm, dry season. It has been

found in this country reproducing on some old trees two days after hard frost and snow, with the temperature down to 17° F. The quantity of wool, the habit of secreting itself in any crevice of bark, or amongst lichens and moss, all tend to protect it.

Besides apples, it now and again will attack pears, but such is certainly very unusual in this country. Notes have been sent a few times of its presence on perry pears, but I have failed to find it myself on that fruit, nor have I yet found it on the wild crabs.

In very severe attacks in bad years it may not only be found on the trunk, twigs and roots, but also on the leaves and on several occasions it has been detected on fruit, where it has produced discolouration.

Life-history.

The "mother-queen" aphid is oval in form, of various shades of purplish-brown; antennae and legs dark reddish-brown; some varieties are rich plum coloured; all secrete a quantity of white wool from the dorsal glands. These "mother-queens" may be found all the year. Usually they seek shelter in crevices in the trunk, or in and around the edges of distorted growths during the winter, as well as below ground on the roots. During the past winter I have observed them on the young wood protected by the split rind caused by other aphides, probably those from which they were produced. This female reproduces viviparously, and the young (lice) crawl about at first in the wool, and are yellowish in colour. Later these larvae or lice may crawl farther from the parent, but as a rule they remain in close company for some time, forming a small colony. After moulting they assume the dull purplish-brown to plum-coloured hue of the parent.

It is these viviparously produced young that secrete the large quantities of wool, which may hang down in great festoons from the branches.

These larvae soon commence to produce young like their parents, and this method of reproduction may go on all the summer. Very irregularly and very rarely pupae or nymphs arise from the lice during the summer, from which winged viviparous females are produced. July to September is said to be the period over which the winged race may occur. On only one occasion have I been

able to find the winged form, nor have I ever succeeded in hatching it artificially. Mr. Fred Smith, of Loddington, tells me it sometimes occurs in the orchards around Maidstone. The winged viviparous female is dusky chocolate brown with typical *Schizoneura* venation to the wings.

These females fly from one tree to another, and possibly from orchard to orchard. There are no data to show or even give us any idea how far they may travel.

The winged females produce living young or lice similar to those which form the progeny of the "mother-queens," and these go on reproducing until late autumn, and I have even known successive broods continue right through the winter.

On the approach of autumn, a few males and oviparous females are present. As far as observations carried on over the past twenty years go, I can only say this sexual brood is extremely rare in this country. Twice in twelve years it has occurred on one tree constantly kept under observation.

It must not be ignored however, as the wintering in the egg stage is of some economical importance.

The wingless oviparous female is very small, and may well escape observation. In colour she is dull reddish-yellow, in size no less than .003 of an inch. The wingless male is like the oviparous female, quite destitute of a mouth.

This sexual female deposits a single egg and dies, her dead body forming a protection or covering to the shiny dark egg during the winter. In all observations so far made, the egg stage takes place close to the base of the tree, always, however, above ground level.

These ova remain frequently hidden in the crevices of the bark all the winter, and in spring they produce a larva which soon matures into the "mother-queen" form, and which sets to work at a great rate to produce viviparous young.

Thus in two ways we have the Woolly Aphis carrying on its existence during the winter above ground: (1) as living viviparous females; (2) in the egg state near the base of the tree. Besides living on the trunk and other parts above ground, *Schizoneura lanigera* lives (3) on the roots and around the stem below ground. The forms found beneath the soil are just the same as those living above it. There they breed in the same way, produce galled growths

PLATE VI.



A.



B.

A. Woolly Aphis on shoots. B. Woolly Aphis on roots.

on the roots, swollen and cracked areas on the stem, and suck the sap going to the plant.

No ova have as yet been detected below the soil. The actual root form, that is the race that galls the roots, is augmented during the winter by migrants from above. These latter mainly affect the trunk below the surface soil, and these may and do return in spring to become the aerial race. Moreover the actual root form migrates to the trunk. As far as I have observed, this migration is not at any fixed period of time, but is spasmodic, and is frequently accompanied by a winged brood.

The damage done by the root form in this country is certainly severe, but not to the same extent that it is in parts of America. Stedman*, in his most excellent work in tracing this insect's life-history, shows that in Missouri it is the ground form that causes so much damage to the apple orchards in the southern half of the State, and to apple nursery stock throughout the State, and further he says that ninety-five per cent. of the cases of so-called "root-rot" is in reality the result of the attack of Woolly Aphis.

In Britain in 1894 I undoubtedly found this Aphis on the roots of apple trees at Shalford, in Surrey, the trees dying under the attack, and again at Albury in the following year. The attack was looked upon as abnormal, and for some years all cases that came under my notice were paid little attention to. This was due entirely to the fact that in some preparations made from material sent me from Paddock Wood in Kent, *Schizoneura fodiens* was alone present. Shortly after, Connold found the galls on the roots, and the matter was placed beyond doubt, and the statement concerning *S. fodiens* was seen to be erroneous as far as the general attack of Woolly Blight concerns the apple. The cases sent in, were from gardens with currants, lettuce, etc., growing beneath the trees; on re-examining the slides, I find they are *S. fodiens*, doubtless thought by the senders, owing to their producing white wool, to be the same as the specimens actually on the apple roots.

During the past four years very many cases of the ground form have been examined, and many reported to me by growers.

Mr. Wood, of Crockenhall, has been the first to recognise this fact in its practical importance, having lifted no less than

* Bulletin No. 35. Agric. Exp. Sta. Univ. State of Missouri (1896).

40,000 young stock, more or less infested with this pest, treated it with the "gas treatment," and cleared the pest by such means.

Failures in treatment are all because we ignore the presence of the migrating ground form, which we now definitely know to occur wherever the aerial form does, just as happens with the Vine Phylloxera (*Phylloxera devastatrix*).

That the Currant Root Louse (*Schizoneura fodiens*) attacks the apple, there is no doubt, but this is only where currants, etc., are grown under apple trees. That this is exceptional, and that it is the Woolly Aphis that causes the main loss to apple is, however, now an established fact, and is becoming well known amongst all

up-to-date growers.

Thus we have this apple pest living during the winter in three ways: (1) above ground as adults, in crevices of the bark, etc.; (2) in the egg stage, and (3) as a root form below ground.

In summer we get it in two conditions only: (1) As active adults forming an aerial race, and (2) as active adults forming a subterranean race.

Natural Enemies.

These are very few and of no economic importance, except in the case of birds. Of these the Blue Tit (*Parus coeruleus*) is undoubtedly the most important. This useful little bird, which every fruit-grower should encourage, hunts all through the winter for this pest, and does much to lessen its numbers as it does for many other orchard enemies. The Great Tit (*Parus major*), the Tree Creeper (*Certhia familiaris*), and even sparrows prey upon it during the cold months.

No insect enemies are of any great value as natural checks. Some

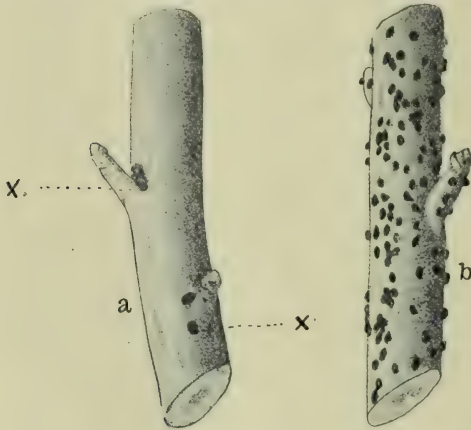


Fig. 1.

a Ova of *Aphis fitchii*.

b Ova of *Aphis pomi*.

PLATE VII.



[A. V. D. Rintoul.

Method of injecting Bisulphide of Carbon.

Coccinellid larvae feed on them, and on some occasions I have seen *Coccinella septem-punctata* clear away colonies of this insect.

A few Syrphid larvae may be seen now and again, but it is very exceptional, and usually happens where we have concomitant attacks of Apple Aphis, which on being destroyed, the Syrphid larvae take to the Woolly Blight.

Rarely larval *Hemerobidae* or Lace Wing Flies have been found with the pest on exposed shoots.

Small dipterous larvae of the genus *Pipiza* were found feeding on the root form in 1899 in some numbers.

Now and again a *Nemocoris* is found sucking their juices, and a few spiders and Harvest-Men (*Phalangidae*) now and then take them.

With the exception of birds, natural checks are of no importance.

Treatment.

The treatment of this disease can only be satisfactorily done if we attack it above and below ground at the same time. There are many washes which will destroy it above ground, granted they are properly employed. It is quite useless to treat trees affected with Woolly Aphis with fine sprays. The trees must be not only well wetted, but the wash must be sent with some force and applied to the affected parts for some seconds. It is essential that first of all the wool is removed ; unless this is done, I know of no substance that will penetrate to the insects and so kill them.

A good hard washing, with ordinary soft soap and quassia is sufficient, but experience has shown that a small quantity of paraffin is beneficial in summer, not more than three per cent. in the wash.

In winter I have just found Mr. Spencer Pickering's wash with paraffin soap and caustic soda most beneficial, and I do not think a better one can be used at this time, although caustic alkali wash has been found for the last six years to kill a very large quantity.

No matter which is used, it is more the thorough application than the actual wash that is of account in this case. Unless the trees are heavily wetted and the wash applied from all directions, it will have but little effect.

For winter washing for Woolly Aphis then, we may use either the old caustic alkali wash or the more improved Woburn Wash.

For summer either soft soap and quassia, or a weak paraffin emulsion. *Force is necessary, and plenty of the wash in both cases.*

The ground form in old or established trees may be destroyed by injections of bi-sulphide of carbon. Nothing else can be used as far as we yet know in this country.

The quantity for each tree, according to size, varies from two to four ounces. This is best applied two feet away from the trunk, four injections for each tree at equal intervals around the stem. It is best injected by means of Vermorel's Injector, shown at work in the figure. The depth of injection is best about six inches.

Care must be taken not to put the fluid on a large root. If the point of the injector strikes a root, move to one side of it. The fumes of the bi-sulphide are deadly to all insect life in the soil, and penetrate deeply into it; they are quite innocuous to plant life, but the actual contact of the liquid is harmful.

This ground treatment must be carried out before April, and in dry weather. The effect in wet soil is as disappointing as it is satisfactory in dry land.

The care of *nursery stock* is very important. Numerous cases have been reported of the introduction of this troublesome pest in new stock. One grower writing from Cheshire during the past year says that it was unknown before he planted some new trees which had traces of it, and that it had become a great nuisance in consequence.

It is very essential that all young stock be fumigated with hydro-cyanic acid gas before planting. The stocks may be placed in a greenhouse or tent rigged for the purpose of known capacity, and then fumigated in the usual way. If done in winter, double the usual quantities of sulphuric acid and cyanide of potassium may be safely used. If nurserymen will not guarantee the stock has been so treated, then it is well worth the grower's while to do so himself.

The Leaf-Curling Apple Aphis (*Aphis pomi* Fab.).

During 1906, a serious attack of this Aphis occurred widely over Britain. Specimens and inquiries were received from Farnham

PLATE VIII.



Damage to Apple Shoots.

The three left hand shoots damaged by *Aphis pomi*, the right hand one normal.

on July 9th, from Godalming and Shalford in the same month, and from various places in Worcestershire, from Ross, from Whimble in South Devon, and from various localities in Middlesex.

In February 1907, great masses of eggs were received from Sittingbourne and Faversham, and Mr. Maxted, of Littlebourne, sent some shoots literally smothered with them. In one specimen, as many as 300 eggs were laid in one mass.

They were laid in all cases on last year's growth, and thus may easily be pruned off and burnt.

Just as with the Plum Aphis, so with this : an early spraying is necessary. So far no wash experimented with will destroy the Aphis eggs, but it has been found that a heavy spraying with lime and salt forms a covering over the eggs and sticks well, and it is hoped that this wash may prove successful as a barrier to the escape of the young apple aphides, as it has proved to be in the case of the Plum Aphis.

The Apple Sucker (*Psylla mali* Förs.).

A large number of inquiries were received from all parts in 1906 concerning the Apple Sucker.

This serious enemy was not so harmful in Kent as usual, but in Worcestershire it had caused enormous loss throughout the whole county. Some orchards visited in Surrey, near Godalming, were quite ruined as far as the fruit went, by this insect. Nearly every truss of blossom had been killed. Many orchards visited in Worcestershire were quite as bad, if not worse.

It was formerly thought that the just expanding buds only were damaged, but observations during the past year showed that fully opened trusses were attacked and killed. It was particularly observable that the attacked trusses remained on the trees as dead, shrivelled masses as late as August ; these gave the trees a very characteristic appearance, by which attacked trees could be identified at some distance. In every dead truss examined in Surrey and Worcestershire could be found many cast skins ; in a few counted, no less than sixty were found in a single truss.

The shrivelled, browned trusses were thought to have been caused by frost by not a few growers.

This damage is not the only harm caused by the *Psylla*, for they also attack leaf buds, and when they do this the opening leaves are seen to be curled and crinkled, and this frequently results in deformed growths.

Thus development of fruit and deformity of foliage may occur side by side, and the consequent result is not only no crop, but decided checking of growth.

The mere absence of blossom does not check this pest, for they can live just as well between the leaves, which the pupae seem to loosely unite by waxy threads and oily globules. The eggs are laid by the green winged *Psylla* mainly on the spurs, but by no means always. Many have been noticed amongst those sent by Mr. Furley amongst the fine hairs on the year's growth, and in Kent I have found some this year on the buds.

The only washes I have found to stick to these are the lime, salt and sulphur, and lime and salt wash.

A Means of Checking Apple Sucker.

Mr. Howard Chapman, of Greenhithe, informs me that he "has quite stopped this serious apple pest by spraying the trees right up to the bursting of the buds with lime and salt. The wash was made by taking fresh lime and putting it in a tub with enough water to make it a smooth paste, stirring until all lumps were dissolved, then adding sufficient water to bring it to the consistency of new milk; strain off into another tub, and to every 100 gallons of lime wash, add 20lbs. of salt.

"Thirty-five acres were sprayed that had not produced a crop for fourteen years on account of *Psyllae*, last year a heavy crop was gathered. Two rows of untreated trees were ruined in the orchard. Few eggs can be found this year on the trees that had been treated."

A number of shoots with *Psylla* eggs on them were thus treated, and it was found that this lime and salt wash held well on to the eggs, forming a coating over them.

It thus appears to act mechanically by stopping the rupturing of the egg shell, and so the escape of the young sucker. Of necessity this wash must be applied late, about two weeks before the buds

PLATE IX.



A.

[F. Edenden.]



B.

[A. V. D. Kintoul.]

- A. Ova of Apple Aphis (*Aphis pomi* Fab.).
B. Ova of Apple Sucker (*Psylla mali* Sch.).

burst would suffice up to the time they are just doing so ; the wash hangs well on the trees, collects especially around the spurs where the majority of the eggs are laid. But rains wash much of it off.

At the same time it has a tendency to retard the bursting of the buds, which is also frequently beneficial. If some fixing substance can be found, that would prevent the limewash from being washed off by rain, then an earlier time for spraying would not matter. A full account of the experiments conducted at the fruit plantations of the College and elsewhere will be issued later. At present all that need be stated is the following :

A. Experiments to find a *cheap* sticking ingredient.

B. The effect on the hatching of other insect eggs.

The following washes were used : (1) plain lime and salt, as used by Mr. Chapman ; (2) whitening and salt ; (3) lime, paraffin and salt ; (4) lime, waterglass and salt ; (5) whitening, paraffin and salt ; (6) whitening, waterglass and salt ; (7) lime, treacle and salt.

Numbers 2 and 7 were soon discarded, the rains at once destroyed 2, and the effect of 7 was very poor. Numbers 3 and 4 have withstood the weather best, and after heavy rains the trees are still coated sufficiently to stop most of the eggs from hatching.

The amounts used of lime and whitening have been much the same, namely 1 cwt. to forty gallons of water, salt 10lbs. to the forty gallons. With the paraffin lime emulsion, 1½ gallons and 1 gallon of paraffin to the 40 gallons were used, and waterglass at the rate of 2½lbs. and 5lbs. to the 40 gallons.

Both rock-lime and chalk-lime have been tried. One series of experiments were with fine ground limes, another with fresh lump-lime, direct from the kilns. At the time of writing the latter with paraffin and with waterglass have proved best, the latter slightly more permanent than the former. The wash wants putting on *very thickly* and thoroughly, so that every part of the tree is covered with a thick coating. If this *hardens* before rain comes it stands well. Even if rains have to be contended with, great numbers of the eggs never hatch out. Possibly the osmotic action of the salt has some effect. Plum trees were also sprayed, and in no case have the eggs of the Plum Aphis hatched ; the untreated trees have now any number of the mother queens on the buds.

A large series of experiments have been made under the Worcestershire County Council by Mr. Furley, in connection with the destruction of *Psylla* eggs in winter, but results are not yet conclusive. Similar washes have been tried by many growers in Kent, Gloucester and other counties, and it is thus hoped that some definite information may be gained from this wide series of trials. An isolated experiment is not only valueless, but very often most misleading.

At the time of going to press, no wash can be recommended for winter use to *destroy* any insect eggs, except the delicate ova of the mussel scale, but the effect of lime and salt as a preventive seems to have the desired effect, and all are deeply grateful to Mr. Chapman for giving us this idea.*

The Mussel Scale (*Lepidosaphes ulmi* Linn.).

This serious enemy of apple trees, especially young stock, was much in evidence again in 1906.

It seems to be especially troublesome in Worcestershire and Kent, most so in the former county, but reports and specimens have been received from Nottinghamshire and Surrey. From Pershore an inquiry was received as to its treatment in December from two market gardeners. The attacked trees were considerable in number. Bad attacks were also noticed in the Ombersley district, one of the worst attacked trees given me by Mr. Gardner was from this district, and is in part reproduced here. In many other districts in the same county, it was found in great numbers (Vide Report on the Orchards of Worcestershire, pp. 14 and 24, 1906).

The specimens sent by Mr. Smith, County Instructor in Horticulture for Nottinghamshire, in February, were smothered with the scale. The trees had been treated by some patent winter wash which had damaged the bark very severely, and in no case were more than half the eggs apparently damaged. Specimens sent by

* Since going to press the Apple Suckers have hatched out in quantities on all the trees treated with winter washes. At the time of writing (April 9th), scarcely any can be found on the lime-washed trees.

PLATE X.



[A. V. D. Rintoul.

THE MUSSEL SCALE ON APPLE TWIG (*Lepidosaphes ulmi*).

Mr. Furley that had been sprayed with double strength caustic alkali wash had all the eggs killed, but at that strength the trees will be severely damaged, at least the young wood. On the other hand the trees treated by the strong paraffin emulsion (Vide Report for year ending April 1st, 1906, p. 32) do not show any damage, and last season carried the best crop for years.

Mr. Spencer Pickering's Woburn Wash has also been found successful at Wye, but some specimens sent me by Mr. Furley had not been damaged at all. There is no doubt that the quantity of paraffin must be up to seven or eight per cent. before any effect

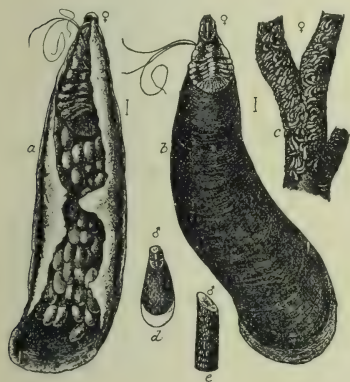


Fig. 2.—*a*, female scale, from below, showing eggs; *b*, same from above—greatly enlarged; *c*, female scales; *d*, male scale enlarged; *e*, male scales on twig—natural size. (From U. S. Year-book, Dept. Agr.)

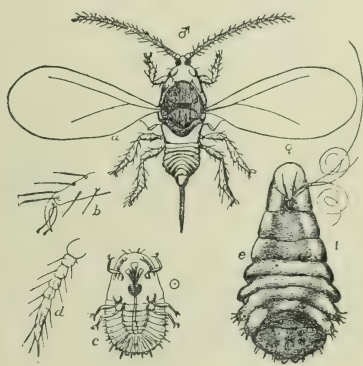


Fig. 3.—*a*, adult male; *b*, foot of same; *c*, young larva; *d*, antenna of same; *e*, adult female, taken from scale—all greatly enlarged. (From U. S. Year-book, Dept. Agr.)

results, and the effect of any wash varies according to the time of application.

Where there is a bad attack, there is no doubt that it is necessary to scrub the trees as far up as possible with the strong wash, and then spray heavily with soft soap and quassia when the young are hatching out.

Mr. Paget Norbury informs me he has killed fifty per cent. of the eggs with lime, salt and sulphur wash, which was found even more beneficial at Wye in 1903 (Journal No. 13, p. 151, June, 1904),

for the two trees treated were completely cleared. Several subsequent experiments failed, hence paraffin emulsion was substituted; in any case the lime, salt and sulphur wash could not be used in the summer.

This scale insect is very abundant in the Mereworth district in Kent, and appears generally to be on the increase. It has also been sent from several other districts in Kent.

It has also been twice reported from Cheshire during the year.

B.—TO CHERRY.

The Buff Tip (*Pygaera bucephala* Stephens).

This insect has been recorded three times during the year attacking fruit trees.

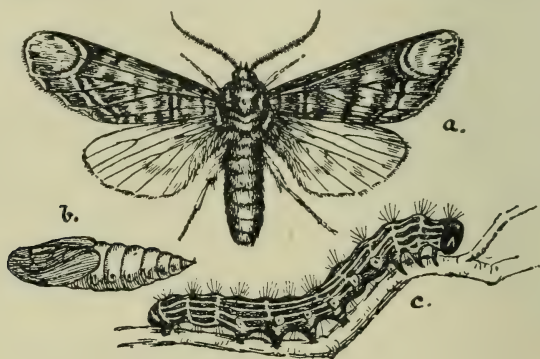


Fig. 4.

THE BUFF TIP MOTH (*Pygaera bucephala*).
a. adult; b. pupa; c. larva (slightly reduced).

The caterpillars were sent by Mr. Lewis Levy, of Borden Hall, Sittingbourne, on the 20th of August, with a note as follows:—

“We have had several cherry trees whose leaves have been almost devoured, and to-day we found the cause in the caterpillars now sent. Over one hundred, I should say, on one tree.”

Another correspondent, Mr. Buley, writing from Woodnesboro', near Dover, sent them with a note saying they were attacking cobs and filberts, and a third that they were defoliating cherries in South Devon.

The Buff Tip Moth (*Pygaera bucephala*), normally feeds on limes, willows and sloes. It is especially harmful to the first-named, and is frequently sent from the suburbs of London as causing damage to the cut-back limes used as "blinds" in suburban gardens. Numbers were also seen during the past year in Hyde Park.

Their attack on fruit trees, however, seems to be novel, and might prove a serious item in cherry orchards. Mr. F. Smith, of Loddington, informs me that they sometimes attack the nut plantations in the Maidstone area.

Fortunately, they appear late, and are easily destroyed by spraying the attacked trees with arsenate of lead.

The Cherry and Plum Tree Borer (*Sesamia woeberiana* Schiff.).

This insect still persists in the Sittingbourne area in Cherry trees. I have failed to detect it or gather any information concerning it in any other part.

The treatment adopted at Bordon Hall of pitching the attacked trunks, is evidently satisfactory. Mr. Levy, writing on the 4th of July, says, "We have had no men to keep the trees with 'borers' constantly pitched, or else I fancy they would soon all be asphyxiated to death, for they seem to be much weaker already where even one dressing has been applied."

The original note sent me concerning this pest was in 1897, and recorded in the Board of Agriculture Journal, p. 165. It was then stated "that for two or three years a couple of cherry trees, planted about nine years ago, did not make the progress they should have done, and upon close examination, little brown deposits were found at the bottom of the trees on the bark; larvae were discovered. Numerous other trees were seen with deposits near the ground, and it was feared the pest might be spreading."

If I remember right, this was the record of an attack at Rodmersham, near Sittingbourne. Since then, Mr. Levy has found it harmful at Borden, and it has continued to some extent at Rodmersham.

In 1887, I found it damaging wall peach trees at Kingston-on-Thames, and eventually caused their death. It is recorded by

Stainton as being common and widely distributed, he referring to it as attacking the laurel.

Kollar, Kaltenbach and Taschenberg refer to it in Germany.

The damage is done to apple, plum, cherry, nectarine and peach, by the caterpillars burrowing under the bark, where they feed on the inner bark and cause an exudation of the sap. Masses of gum appear in the cherry, swellings and rugosities in the others, and the trees gradually decay under the attack.

The burrows formed by the larvae are of irregular form, sometimes chamber-like. Air holes are made by them, and out of these a brown granular "frass" is extruded. These "frass" heaps were particularly noticeable on the pitched trees at Borden Hall, the larvae eating their way through the pitch for air, and to pass out the excrement.

The attack mainly seems on the base of the trunk, and up to about four feet. As many as ten openings were found on the trunk of one tree last year.

Life-history.

The moths appear in May and again in September, there being two broods during the year. They settle when at rest on the trunks of the trees, and are then very inconspicuous.

The wing expanse varies from half to nearly two-thirds of an inch. In colour they are dull orange-brown to chestnut-brown on the forewings, with dark markings, small dull yellow streaks on the costa, and a distinct eye-like spot on the tip of each wing, and a pearly border enclosing three dark lines; the underwings are unicolourous brown. The moths appeared in 1901 and last year on May 21st, and continued until June 6th. They laid their eggs in crevices in the bark, and in six days the small caterpillars appeared and tunnelled at once into the inner bark, where they pupated in late August and in September.

The caterpillars are dull pinkish-white to pale dusky-brown, with a dark bi-lobed head and two large median and small lateral dusky tubercles on the first six segments, a simple hair arising from each; on the four following segments are two small extra dorsal spots behind the two large ones, and the tail end is darker than the rest.

The chestnut-brown pupa works its way partly out of the exit hole before the moth emerges.

The second brood, which mainly occurs in September, lay their eggs in a similar manner, and the larvae remain feeding under the bark all the winter. They commenced to pupate last year on April 30th, and had finished the second week in May.

The larvae, when mature, reach a little over half-an-inch in length. The pupae are slightly shorter.

Prevention and Treatment.

Prevention may possibly be carried out by smearing trees in infested orchards, at the time the moths are about, with some noxious mixture. Cow dung or clay, and lime would make a good mixture; a good smearing of grease, if a pure sample is obtained, might be similarly used.

Mr. Levy's plan of thickly coating the stems with pitch has been found to do no harm to the trees, and has certainly reduced the numbers of the insect. A good brushing or painting with arsenate of lead and clay would kill the caterpillars eating in or out of the trunk if put on thickly. If only a few trees are attacked the larvae may be got at by cutting into the tunnels with a knife, or probing with a stiff wire.

The Cherry Fruit Moth (*Argyrethesia conjugella* Fab.).

This fruit pest has been recorded from Kent by Mr. Whitehead, but I have failed to find traces of it, although one grower near Sittingbourne tells me he thinks he has had it in his orchards.

During the past year it was reported from near Stourport.

This caterpillar attacks the apple and other fruits and is well known on the Continent. It is a native of this country and is fairly widely distributed feeding in the berries of the Mountain Ash.

A Common Shield Bug (*Tropicoris rufipes*, Linn.) **attacking Cherry Trees.**

This large and handsome Shield Bug was received from Mr. Emptage in August, with a note that it was swarming over Cherry trees at St. Ives, Huntingdonshire, and doing considerable damage.

Larvae, nymphs and adults were sent, all taken at the same time.

No mention was made as to whether it had attacked the fruit. An allied species, *Peltophora pedicellata* Kirby, called the Cherry Bug, attacks the fruit in New South Wales (Miss Publications, No. 538, "Notes on Australian Hemiptera," p. 3, 1901. Froggatt).

This is a very abundant insect, met with in most localities in woods, fields and gardens. It even occurs in London. Although it is said to be generally carnivorous in habits, and to live mainly on the juices of caterpillars, I do not think that is the usual food, and believe it to be almost exclusively vegetarian. Professor G. H. Carpenter tells me he finds it mainly vegetarian in Ireland. The specimens received from St. Ives differ from the type in having a yellow apex to the scutellum, not an orange one. Mr. Distant does not know the variety, and it is thus possibly undescribed.

The larvae and nymphs have a particularly obnoxious smell.

They are easily destroyed by jarring them off the trees and crushing on the ground. It will be interesting to see if this new habit of *Tropicoris rufipes* becomes permanent, or if it will remain an isolated case.

The Cherry Black Fly (*Myzus cerasi* Fab.).

The Black Fly or Black Blight of the Cherry was reported from various localities during 1906. In Kent it attacked both sweet and sour cherries. In Worcestershire it was very noticeable, but it appears to do but little damage on old established trees according to Mr. Ballard, although many shoots were seen to be badly struck. It is on wall fruit that it causes the most damage, namely, by covering the cherries with its gummy honey-dew, which soon is covered with the attendant black fungus.

It can very easily be kept at bay if attacked soon enough. I have found that it nearly always first starts on the small shoots that may be seen near the ground or on the lowest leaves; later on as seen in the photograph reproduced here, on to the tender young shoots, and thus gets to the leaves when the shoots are crowded. If the trees are washed when in the condition seen in the figure, then



[A. V. D. Rintoul.
BROWN CURRANT SCALE
(enlarged).]



[A. V. D. Rintoul.
THE CHERRY BLACK FLY (*Myzus cerasi*) thickly
clustered on young shoot.]

the Aphis is readily killed, but if they are allowed to get to the leaves and curl them up, then it becomes a most difficult matter.

There is nothing so good as soft soap and quassia, the more of the latter added to the wash the better, as it not only seems to make the plant obnoxious to the Aphis, but also acts as a very strong astringent to the leafage, and so cleans it from the black, sticky mass.

C.—TO CURRANTS.

The Currant Clearwing (*Aegeria tipuliformis* Linn.).

This currant insect still persists in plantations in Kent, but the damage it does now is very slight. Although it is mainly black currant that is used as food by them, they now and again attack the red and white varieties.

During the past year specimens have been sent in black currant shoots from Malvern, Mereworth, Tonbridge, Ramsgate and Canterbury.

From Woodnesboro' it was reported as attacking gooseberries. I do not think that this has been noticed before. The exit hole A. Fig. 5, was quite absent in two shoots sent, but it may usually be detected, and thus acts as a guide in winter to enable us to detect infected shoots.

An Unknown Black Currant Fruit-Moth.

Whilst in Worcestershire several growers pointed out the damage caused to black currants by a caterpillar. No such attack has before been recorded in this country and, unfortunately, no live material could then be obtained. There are several microlepidoptera that

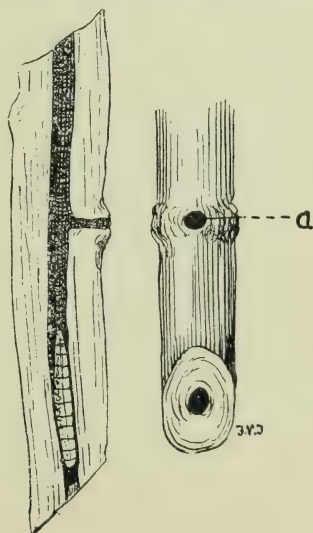


Fig. 5.

Black Currant Shoots attacked
by Currant Clearwing.

a. Exit hole.

will feed inside gooseberries, and also small geometers on the Continent, but it is not possible to say anything definite until the species is bred out and identified. It was said that the larva lived inside the berries. The result was very marked, the attacked fruits holding on the bushes as dried husks with a large more or less circular hole in them.



Fig. 6.

THE CURRANT CLEARWING

(Nat. size).

The Brown Currant Scale

(*Lecanium persicae* var. *coryli* Linnæus).

Attacks of this Scale insect were reported from near Canterbury and Essex on red and white Currants. The same insect was sent, with inquiries as to treatment, from Ledbury, Herefordshire, attacking gooseberries. On the currants it does not seem to do much harm, but nevertheless, it must have some weakening effect. On gooseberries it is frequently very serious.

It has also been reported from Worcestershire on gooseberries during the year. Some very badly incrustated shoots were sent by Dr. Durham from near Hereford.

In March a bad attack on red currants was brought to my notice at Godalming.

Treatment for this pest is best applied in winter, when a good spraying with caustic alkali wash will remove the young insects and old scales.

This insect passes the winter in the full fed larval stage, scarcely visible to the naked eye, and rarely in the egg condition. They moult in spring, and soon reach maturity, and generally lay eggs in May, the pale larvae hatching in June, and these crawl over shoots and leaves; those on the leaves die in the autumn, when the leaves fall. Larvae have also been found in February, and these became mature females in May (2nd). The eggs hatched out in June, and mature females came from them in August, and in 1902 these females laid eggs which gave rise to larvae in September, and by October these again laid eggs, from which sprung larvae, which wintered on the bushes. Thus in that year four broods occurred. Three have been traced since, and two last year. My friend,

PLATE XII.



[A. V. D. Rintoul.]

BLACK CURRANT BUD MITE.

Left hand shoot, normal ; right hand attacked by the Mites.

Mr. Newstead, one of the greatest authorities on Coccidae, expressed surprise, and I felt some doubt at the account of the habits of this scale given in No. 11 of the *Journal* of the South-Eastern Agricultural College, pp. 23-24 (1902). Fearing that I had made some mistake, the life-history has been followed two years in succession, and the same has occurred as recorded there, only that I could trace but *two* generations in 1906.

Last winter, although many mature larvae were found hibernating, several specimens were found in the egg stage. I notice in his great work on British Coccidae, Vol. II., p. 92, he says, "Eggs are laid about the middle of May *under glass*" (the *italics* are mine). One would naturally expect two or more broods under glass, and only one in the open. This does not seem to be the case, but difference in food plant may easily account for such vagaries in life-history. I may say here there can be no doubt as to identification, because Mr. Newstead kindly checks all naming of scale insects for me.

Specimens were sent from Denmark for identification, from currants and elms. The elm is a new food plant. The young scales had taken up their winter position on the back of one of the old adult females. A feature of much interest according to Mr. Newstead.

The winter treatment with caustic alkali wash evidently affects mature hibernating larvae, and as we know, brings off the dead brown scales, also those containing eggs at the same time, and thus checks the increase of the pest.

The Currant Mite (*Eriophyes ribis* Nalepa).

One hundred and seventy samples of black currant cuttings and buds have been received during the past year for examination. In several cases one or two buds only have been detected by the growers to be swollen in December and January. By the removal and burning of these, and at the same time any buds near them that show no signs of presence of the mite, the disease can easily be stopped from spreading.

Cuttings sent by Mr. Paget Norbury, from Malvern, others from the Horticultural College at Swanley, had all the buds

examined, and no mites could be detected in any buds except the one or two basal ones that were swollen.

This mite has been seen attacking Red Currants. This attack, and on white also, was recorded in the last Report, but specimens were not received.

Some *enemies* of this mite have been sent me during the past year. The most interesting came from Northumberland. In May Mr. Gill, writing from Barras Bridge, Newcastle-on-Tyne, sent me some "big buds," which were being devoured by Tortrix larvae. The larvae were found feeding inside the buds, and very rapidly hollowed out the buds and destroyed the mites. The few larvae sent were kept and placed on a currant bush, affected with "big bud," and it was found that they only attacked the swollen buds.

They proved on hatching, to be *Tortrix* (*Lozotaenia*) *podana* Scopoli),* which is recorded as feeding on oak, bramble, etc. The caterpillars are green, darker green on the back, with black spots and brown head.

They spun up, and pupated in a scanty silken covering, not a dense cocoon, amongst the dead buds and leaves, and hatched in July.

Whether or not it will prove of any use locally in checking the bud mite remains to be seen, but such is considered to be very unlikely.

From near Greenhithe, Mr. Chapman sent me buds, every one of which contained the maggot of a Muscid Fly. This larva clearly feeds on the mites, but judging from the numbers of mites still in each bud, it can do but little good. Like the Cecidomyian larva, observed by Mr. Warburton, it appears to feed but little and grows slowly. Mites were very frequently found crawling all over them.

A similar larva was also observed by Mr. Lewis, and is mentioned in his detailed account of the Currant Gall Mite in the *Journal* for 1902 (p. 65).

Experiments now continued over thirteen years have yet failed to offer any hope of a remedy for this pest.

* The Synonymy of this moth is somewhat complicated:—*Tortrix* (*Lozotaenia*) *podana* Scop.; ♀ *Oporana* Fb.; ♂ *Pyrastrana* Hb. D.L.; ♀ *Congenerana* Hb.; *Gerningiana* Haw.; *Ameriana* Tr.; *Rosana* Fröl.; *Fulvana* Wilk.; *Oporana* Haw.; v. *Fuscana* St.

PLATE XIII.



[A. V. D. Rintoul.]

Abnormal attack of *Eriophyes ribis* Nalepa on
Red Currant.

Mr. Collinge, in the *Board of Agriculture Journal*,* shows that he has destroyed it by dusting with lime and sulphur. This has been carried out for two seasons on some bushes (twenty), and this year the big-bud is worse than ever. The bushes were not dusted as Mr. Collinge suggests, three times, but last year thirteen times.

Migration of the mites is spread over too wide a period to ever hope that this treatment will do any permanent good. But it is encouraging to know that some success has been attained. We trust growers will try this treatment to see if any benefit is derived. There is no doubt that by growing varieties that resist to some considerable extent the parasite, such as Boskoop Giant, and the French, together with hand-picking, that the disease may be kept in check. Mr. F. O. Walker, of Ulcombe Place, wrote in October that "big-bud" was bad there, but that by hand-picking in April he had prevented any further increase. Mr. Lewis Levy, of Borden Hall, Borden, also writes me that he keeps it down by the same method. Very many other cases have been reported by growers in all parts of England, showing that this is the best method of procedure.

Some experiments have been made to try and fill in several of the quite unexplained features in the life history of this mite. It is well known to fruit growers that if the bushes are cut right back that the new shoots come up with big bud as bad as ever. Fresh infection has been given as the reason. It is no such thing. Six bushes were cut right back, and the stocks cleaned and put in isolation boxes. In all cases but one the shoots developed big bud. The investigations were checked, owing to pressure of work, but in the only bush examined, mites were found living under the rind of the stumps.

A Peculiar Attack of the Big-Bud Mite on Red Currants.

Mr. Thomas Edwards, of Grange, Gillingham, Kent, sent in November, a Red Currant bush of very curious and abnormal growth. This was the second he had found.

Later, Mr. Edwards wrote that he had had such a bad attack of Big Bud in the Black Currants that he had destroyed them by

* Vol. xiii., No. 10, p. 585 (1907).

burning. The attacked Red Currants were raised by himself, and not imported.

The resulting disease caused by the mites presented such very marked features that I decided to send the acari to Dr. Nalepa, of Vienna, who reported that they were undoubtedly the *Eriophyes ribis* Nalepa, that causes the "Big Bud" in Black Currants.

The attacked bushes were very wisely burnt by the grower.

The mite caused a dense growth of buds, every here and there, which were found to be teeming with them. At the same time the shoots bearing the attacked buds were abnormally swollen, many twice the thickness of normal ones.

Although the buds were teeming with mites, no trace of eggs could be found. The dense mass of buds occurred in smaller areas all up the stem, as shown in the photograph.

This new working of the Gall Mite is certainly far more serious in the Red Currant than in the Black, and growers cannot do better than burn all bushes in which it appears, on the first sign of disease.

A Tortrix (*Tortrix podana* Scop.) feeding in Big Bud.

Mr. E. Leonard Gill, writing from Barras Bridge, Newcastle-upon-Tyne, on May 29th, sent twigs of Black Currants badly attacked with "big-bud." He wrote as follows:—"I sent samples of Black Currant twigs which have been damaged by some insect. The bushes in this neighbourhood are being damaged a good deal in this way this year. The caterpillars in the samples, appear to be those of a Tortrix, possibly an *Antithesia*, etc."

In early June, Mr. Gill wrote saying that there did not appear much hope that the caterpillar was doing much to check the increase of the mites, but that he was obtaining evidence to bear on the subject.

On June 19th, Mr. Gill wrote: "I have been unable to obtain a proper supply of 'big buds' to feed the Tortrix on, and they seem to regard the 'big-buds' very definitely as their proper food. Two of them have already spun up in leaves, and it is possible that these will emerge in due course."

PLATE XIV.



[F. Edenden.]

Red Currant bush with foliage destroyed by Sawfly
larvae (*Nematus ribesii*).

Finally, Mr. Gill writes on August 21st that he had bred *Lozotaenia fulvana* (*pyrastrana* or *podana*), but that he does not see that they will have any definite effect in checking the disease.

D.—TO GOOSEBERRY.

The Gooseberry Sawfly (*Nematus ribesii* Cameron).

Numerous inquiries have been received concerning this pest, as happens every year. From Christchurch, Hampshire, Mr. C. A. Boughton Knight wrote in May, asking for a wash to kill the caterpillars, as they were very abundant. Another inquiry came from Mollington, where it was very harmful in 1906. Another correspondent wrote that it was doing much harm at Chesterfield.

Practically every gooseberry plantation in the country suffers, more or less, from this insect, and there is no doubt that its ravenous nature causes great harm to the bushes by checking their growth and the maturing of the wood, but this is not always so.

Further experiments have shown that by far the best treatment is the use of hellebore as a wash.

A grower once stated he could kill these larvae with soft soap and quassia: this has now been tried for two seasons, and no benefit whatever has resulted. But it is quite possible that if this wash is applied with force it will knock the larvae off the leaves. If very bad samples of soft soap are used the very young delicate larvae would probably be harmed. With Chiswick soap nothing happened on the bushes sprayed last year.

Growers had better retain well tried systems than apply new ideas that may or may not be successful.

The Gooseberry Sawfly need now scarcely be referred to in detail as its life-history and treatment are quite well known. The three localities mentioned here, however, are new, and may prove of some future interest.

A New Midge (*Cecidomyia* Sp.) attack in the Gooseberry.

An extremely interesting attack on gooseberry bushes was sent by Mr. Bickham, of the Hilltop, Ledbury, in November. The disease was not new, and had been attributed to *Botrytis*.

Mr. Bickham, writing on November 5th, says, "The history of the plants is as follows:—I bought about 3,000 bushes of Crown Bobs in the spring of 1905, as two year olds, from a good nurseryman. They were heeled on my farm and lay there covered with snow for about a week, during which time mice got amongst them and ate out many of the buds, so much so, that many of them had to be stumped back into old wood. When the weather broke they were planted out in a field that had two months previously been pasture. The field was double ploughed, so that the turf was well covered over. The bushes started capitally in the warm soil, but after making six to nine inches of growth, they stopped altogether about July, and the shoots died back like those of the sample sent.

Last winter I sent a bush to . . . who reported the disease was due to *Botrytis*, and following directions all prunings were burnt, and the bushes made quite blue with sulphate of copper; but in spite of this, the gooseberries have again all gone wrong. The same mycologist pronounced samples from Putley Court to be due to the same fungus. In a three-acre plot of Whinams adjoining that on which my Crown Bobs are planted, I have never seen a dead shoot, nor have dead shoots been found on Lancashire Lads and Warringtons in any number—a few on the latter here and there, etc., etc."

No trace whatever of *Botrytis* could be found on any of the shoots save two, and these were *dead shoots*. No trace of the fungus was detected near any sound wood.

Specimens were also examined by Mr. Salmon, and none were found by him.

The cause was soon seen on careful examination, to be due to small orange yellow maggots, which proved to be an unknown Cecidomyian. The larvae occurred in every dead shoot, sometimes one or two, sometimes as many as six. They were found in all positions: some in the dead tissue, others at the junction of the dead and live tissue, the majority in the latter. Shoots kept under observation showed that the larvae worked downwards, and were the cause of the death of the shoots. These larvae also were found by Mr. Rothwell, who helped in the examination of the buds.

Thus they occurred in three positions: (1) in the centre of the shoots; (2) the buds; and (3) between the rind and the wood.

The following additional note was sent by Mr. Bickham:—

“A few dead shoots were found in the adjoining field in November, and these on bushes which were nearest to a dividing way, through the hedge which divides the infested plot from the other fields. I broke a dead shoot,” said Mr. Bickham, “and underneath the bark found five or six orange maggots. Although I hunted further very carefully, it appeared that the hedge had formed a very useful barrier to the pests’ further progress, the gap alone having allowed it to spread.”

As there was no trace whatever of any *Botrytis* on the majority of the dead shoots, and as the larvae occurred in great numbers where no *Botrytis* was present or had been present, and as the larvae were watched at work, we can safely say they are the cause of the damage. The only two shoots which had any *Botrytis* happened to have yellow larvae, and at first it was thought that they might be fungus feeders.

The question of the identity of this new gooseberry pest is not yet decided. No such attack is known in Europe or America.

On both Continents a *Cecidomyian* Fly related to it, called *Cecidomyia grossulariae* Walsh, attack the fruit. The winter stage is not known of this species. In the summer, however, it attacks the berries. Mr. Bickham informs me that no damage whatever was done to any of the berries which were bottled down, and remained quite sound.

No proper description has been given of the larval stage of *C. grossulariae*, and thus we cannot say with certainty that it is or is not the same as the insect at Mr. Bickham’s, but as he is such a careful observer, we may be fairly sure that it is not the same as the Continental and American fruit feeding kind.

Nothing new seems to have been known of the American pest since Fitch’s “Report on the Noxious Insects of New York” (First Report, p. 176).

As this is of some interest in connection with this disease, the original account kindly sent me by Dr. L. O. Howard, Chief of the Bureau of Entomology at Washington, is appended.

An account of this insect and the structure of the larva will appear in the Entomologist during this year.

THE GOOSEBERRY.

AFFECTING THE FRUIT.

The young fruit becoming red and putrid, containing within it one or more small bright yellow maggots.

The Gooseberry Midge (*Cecidomyia grossulariae*).

It is common to find upon the gooseberry bushes in our gardens some of the young fruit of a prematurely ripe appearance, turning red and dropping to the ground. Some years much of the fruit is lost in this way. This premature ripening of the gooseberry is caused by insects puncturing and depositing their eggs in it. We have at least two insects which thus attack the gooseberry. One of these appears to be a species of moth which I have not yet obtained in its perfect state. The other is the larva of a midge or a small two-winged fly, of the genus *Cecidomyia* and family *Tipulidae*. On examining some of these affected gooseberries early in July, their pulp was found to be putrid and infested with small maggots of a bright yellow colour and oval form, their bodies divided into segments by five impressed transverse lines, and their whole appearance being closely like the larvae of the Wheat Midge, found in the ears of wheat. These completed their transformations and gave out the winged flies the latter part of the month of July. In size, number of joints to the antennae, etc., these correspond with the *C. ribesii* of Europe, but that is described by Macquart (*Dipères*, vol. i. p. 162) as having black bands upon the thorax, the abdomen blackish, etc. Hence it is evidently a much darker coloured species.

The Gooseberry Midge is scarcely the tenth of an inch in length to the tips of the closed wings. It is of a pale yellow colour, the thorax paler than the abdomen, and of a wax-yellow hue; eyes black, antennae blackish, of twelve joints, separated by hyaline pedicels one-third as long as the joints, which are short, cylindrical, with rounded ends, their length scarcely more than double their breadth; legs straw yellow, faintly tinged with dusky towards their tips; wings hyaline, faintly tinged with dusky.

It is probable that those flies which come out the latter part of July deposit a second crop of eggs in the gooseberries, or else resort to some other fruit of a similar nature, and that the larvae which come from these eggs lie in the ground during the winter; for we do not perceive how, otherwise, there can be flies in June to deposit their eggs in the young fruit.

All fruit upon the gooseberry bushes which is found prematurely decaying and assuming a ripened appearance, and all which falls to the ground, should be gathered and thrown into the fire, to destroy the worms which the berries contain. By attention to this measure the haunts of this insect in the garden

can be easily broken up, whereas, if this step is neglected the evil will be liable to continue year after year. As this insect breeds equally well in the wild gooseberries, we cannot hope to exterminate it from our country. But none of these wild gooseberries should be permitted to grow in the vicinity of the garden, for from them, if near, this midge will continually be finding its way to the bushes of the cultivated gooseberry.

(Fitch's Noxious Insects of N. Y., First Rept., p. 176.)

The only other *Ribes* feeding species is the *Asphondylia ribesii* of Meigen (Macquart, 1834), which lives in the curled, crinkled leaves of the Red Currant.

The probability is that this is a native insect which has increased locally, and of which we know nothing because this very important group of flies has been scarcely paid any attention to.

It may not be only a *Ribes* feeder, for insects have a habit of changing their food plant, but may have come from some other plant.

Observations.

It is found that the larvae partly remain in the dead and dying shoots during the winter, but that by no means all do so.

Those that lived between the rind and the wood partly fell to earth owing to the rind rupturing. There they pupated. Thus burning the pruned dead shoots in winter would not stamp out this disease, a certain number being carried over in safety in the soil.

Slugs damaging Gooseberries.

Some three or four years ago, Mr. John Riley wrote regarding the damage to young gooseberries by slugs, but as he was unable to have any caught, the exact cause remained in doubt until last year. They eat the base of the calyx, and then go on to another gooseberry; the gooseberries thus attacked die and fall off.

Mr. Riley's manager, visiting Evesham, found that in one garden, the whole of the crop was destroyed, scarcely a gooseberry being unbitten. This attack in that neighbourhood had been put down to frost. Mr. Riley, writing last May, says: "We had a very bad attack on two or three acres close to where it was first, and they

were heavily washed with Little's fluid sheep-dip ; they do not appear to have suffered from it : it was used strong (one to seventy)." Later information sent showed that this damage was undoubtedly due to slugs, Mr. Riley stating that " careful examination at night revealed the fact that slugs were the culprits. We have caught them red handed. In order to make climbing easy for them, we cut off branches of the gooseberries, and stuck them in the ground at night. Several slugs were soon seen eating the calyces as described, and they were found in quantity under most bushes at night. Had we no foxes, I should try 500 ducks to clear them off."

There is no doubt that the employment of these natural enemies is one of the best ways of ridding a plantation of such pests. It would be quite possible even with foxes present, to use them during wet weather in day time, when the slugs would be on the move.

This has been done in cases of slug attack in hop gardens with good results.

There does not seem to have been any previous notice of these mollusca doing harm in this way.

The attacked blossoms sent showed very characteristic signs of damage ; the eating away of the base of the calyx causes shrivelling which might be mistaken for frost-bite if not examined, but the work of the slug can easily be detected if looked for.

E.—TO LOGANBERRY.

Three distinct insect attacks have been reported on Loganberries, namely, the Raspberry Beetle (*Byturus tomentosus*), in Worcestershire, the larvae living in numbers in the fruit just as they do in Raspberries, only apparently causing far more damage, the Red-Legged Weevil (*Otiorhynchus tenebricosus*), and the Raspberry Weevil (*Otiorhynchus picipes*), which have attacked them in the Cheddar district of Somersetshire, just as they do Raspberries and other plants.

F.—TO NUTS.

The Nut Sawfly (*Croesus septentrionalis* Linn.).

Writing in September, Mr. Buley reports that he has traced two distinct broods of this Sawfly on the cobs. The second brood

went to earth the last week in September, which was rather late. Osiers were also noticed entirely stripped of their leaves by these larvae at Woodnesborough. The attack on nuts mentioned in the last report (pp. 42-45) does not seem to be unusual, for two growers tell me they have noticed the damage done by similar caterpillars, and they were found in 1906 near Wye feeding on Filberts and Hazels in several widely separate localities.

No notes have been made on the exact method and place of

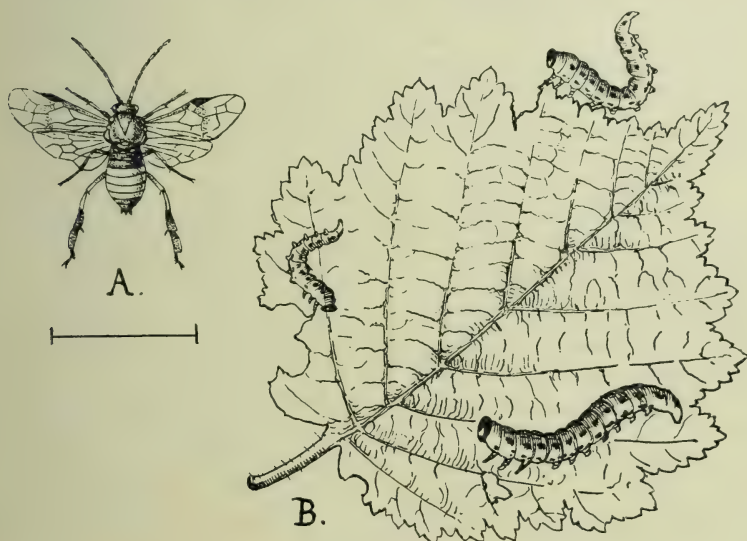


Fig. 7.

THE NUT SAWFLY (*Croesus septentrionalis* Linn.). A. Adult ; B. Larvae.

oviposition, or on the eggs themselves, and these would prove of value as completing what we know of the life-history.

The Bright Marble or Nut Tortrix (*Carpocapsa splendana* Hb.). Imported in Spanish Chestnuts.

This moth, which is closely related to the Codling Moth, is by no means of common occurrence in this country, but it is fairly widely distributed in the south of England.

During the past year attention has been called to it on account of the numbers that have been introduced in foreign Spanish chestnuts. They were actually found crawling in a street in a Kent village, and were traced to a local store close at hand.

Normally in this country the larva is said to feed on acorns. In 1890 I found it in some numbers at Ninfield, in Sussex, amongst Spanish chestnuts, and found later that it attacked the fruit.

On two occasions in 1884 I noticed maggots in walnuts on the trees, but not until 1894 could I trace any appreciable damage done by them.* The specimens were bred out and proved to be this insect beyond doubt. During the late autumn of the same year, several samples of walnuts were sent me containing the same larvae. At Interlaken, in the Bernese Oberland, I noticed a similar attack in 1889.

The importation of this insect is certainly not wise, and growers who have walnuts should be very careful in keeping a look out for these insects in local stores, and try and get the infested stuff destroyed in some way.

Life-history.

The moth appears in June and July and lays its eggs on the young fruit.

In size it is from one-half to two-thirds of an inch across the wings. The forewings are whitish-grey, basal patch grey, its outer edge angulated, streaks of grey along the costa, at the hind margin is a large blackish-brown area enclosing a silvery-edged ocellated patch, in which are three or four black longitudinal lines.

In ten days the eggs hatch and the maggots enter the young fruit.

The larvae are pinkish-white, with the head and first segment brown and about the size of the Codling Maggot, but not so fat. Those received last year from Spanish chestnuts were all dirty yellowish white, one only showing traces of pink.

They leave the fruit, when mature, by a remarkably small hole, the larva taking half-an-hour to escape.

* "Notes on Insect Pests in 1894," p. 21 (1905) F.V.T.

Pupation took place on the walnut trees in the same manner as is done by the Codling Moth, and probably the same occurs on the Spanish chestnuts. Larvae were observed last year as late as November 31st, and one in December in imported nuts.

Observations made in 1894 showed that they crawled up the walnut trees, spun a dirty white silken cocoon, and pupated in the spring. Morris says they pupate in a brown cocoon in moss. There were also some cocoons found in rough grass beneath the trees, and some larvae remained in the nuts all the winter, leaving them in February.

Should this moth become a serious nuisance in walnuts the banding found so successful for Codling Moth might be adopted.

The importation of this insect is a matter that must not be forgotten, and is certainly attended with some danger.

The Nut-Leaf Blister Moth (*Lithocolletis coryli* Nicelli).

Nut leaves both wild and cultivated are often seen to be marked with large pale blisters, ranging up to nearly half-an-inch in width. These blisters are sometimes roundish, at others rather elongate. They are caused by a small leaf-mining moth caterpillar, known as *Lithocolletis coryli*. These mines occur on the upper sides of the leaves. Another species, *Lithocolletis nicellii*, occurs on the lower sides, but I am not sure if this species occurs in Britain.

During the late summer of 1906, the nut leaf miner seems to have been abnormally abundant, both in the hedgerows on hazel and amongst cultivated cobs and filberts in many parts of Britain.

The damage done to the leaves especially in young plantations must have been severe, checking the further growth and development of the shoots.

In this country it is common in Devonshire, Somersetshire, Gloucestershire, Surrey, Kent, Cheshire, and has occurred in various parts of Yorkshire (Stainton recording York, Scarborough and Stockton-on-Tees), the last named authority also gives the Cumberland Lake district, and Cockburnspath, in Berwickshire.

In 1906 it was very abundant in parts of Kent, some cobs being seen with all the leaves blistered, many having six or seven

blisters on them. Badly attacked trees were seen in Devonshire, but I only noticed it in one place in Worcestershire and one in Herefordshire.

Life-history, Habits, etc.

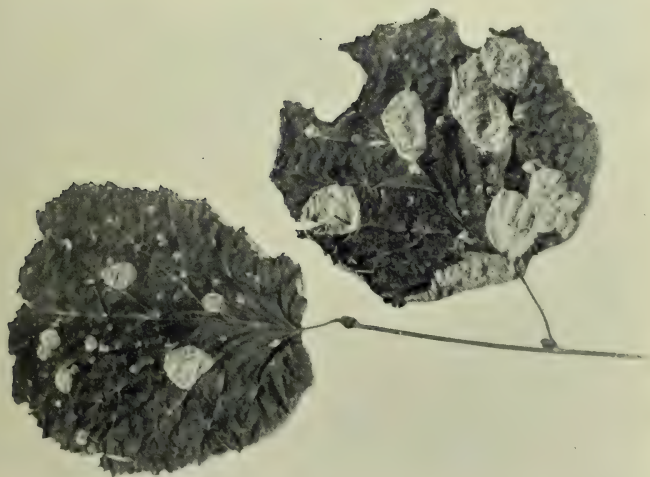
The moth appears in May: in 1906 as early as May 12th at Wye, the year before not until 27th. In size it varies from 7 to 8 mm. in wing expansion. The anterior wings are pale ochreous brown, with a snowy white basal streak, and on the inner margin a thin white streak much smaller than the above; towards the apex four white converging areas above and three below; the hind wings are white with dusky base, and the long fringes are grey in the female, of a dull yellowish tinge in the male. The thorax is the same colour as the wings, with a median and lateral white stripes. The abdomen is grey, and the tuft pale ochreous. The legs are grey, with white tarsal segments spotted with fuscous.

They lay their eggs on the leaf, choosing, it seems, a still, fine evening just before sunset. The larvae then burrow into the leaf, and feed upon the soft mesophyll and eat it out in a more or less rounded area, the upper epidermis being left intact, but quite separate from the rest of the leaf and shows quite white (I have never seen the ochreous central area described by Stainton). Occasionally, when the mine is near a mid rib or the edge of the leaf, the leaf becomes much puckered and folded.

In this blister the larvae may be found up to the beginning of July.

When mature the larva reaches about 4.5 mm. in length. It is pale yellowish-green, the first three segments more yellowish, and the eighth with a somewhat obscure orange yellow spot; the last two segments are yellowish. The head pale brown, with dark brown markings; when retracted the lobes show through the first segment as two brown spots. Legs very pale.

This larva, when quite young, lies in a curved position, but as it reaches maturity it straightens out. It can generally be seen in the mine at work by holding the leaf up to a strong light. Some dusky spots are noticeable beneath in the young larva, but they soon disappear.



Nut leaves attacked by larvae of the Nut-Leaf
Blister Moth.



Pear fruitlets, normal and attacked by the Pear Midge (swollen ones).
[*F. Eldenden.*

Pupation takes place in the blister, and by the first or second week in August a second brood of moths appear. These soon pair, and lay their eggs as before. If circumstances are favourable, a great many eggs are laid, and the result as we saw in 1906 is that the leaves become covered with blisters in September. This second brood of larvae reach maturity in early October. They then pupate as before, and the moths hatch out and hibernate. At least, this is what is apparent, for they have not been observed in any other condition during the winter.

I have failed to find any winter pupae in the leaves, and yet all the larvae pupated there. Those kept hatched out, and none could be found in the leaves naturally.

Unless I am much mistaken this is the normal way of wintering, and thus we have another reason for separating this nut species from *Lithocolletis carpinicolella*, which is found in the pupal stage in the dead leaves of the hornbeam, which hang so readily on to the trees during winter. The adult of *L. carpinicolella* is, however, very like *L. coryli*.

Treatment.

This is very difficult, but I found a heavy spraying with arsenate of lead used for Nut Weevil kept the trees clear of the first brood, but that the second brood invaded the same trees from some old cobs and filberts standing close by.

A heavy spraying of arsenate of lead is undoubtedly good for nuts if used in May; at this time the Winter Moth, Nut Weevil, Leaf Weevils, and these Miners can all be attacked by it, and as it holds on to the leaf well, later comers, such as the Croesus Sawfly and the Buff Tip Moth, are also destroyed.

G.—TO PEAR.

The Pear Midge (*Diplosis pyrivora* Riley).

This pest has not been so harmful generally during the past year. The reason undoubtedly being the destruction of the previous year's blossom in the west of England, thus killing the only abode where the maggots can mature. The result has been that there has been a small crop of pears in the Western Counties.

Although it has been reported some dozen times, in one locality only has it been recorded as very harmful. The Reigate area of Surrey seems to be badly attacked. Mr. R. S. Ragg, of the School House, Reigate, has taken this matter up in a common-sense way and is endeavouring to get concerted action in destroying it in the neighbourhood. Unless this is done, or unless nature steps in and frost cuts off all the blossom, not much good will result from isolated treatment, when the fly occurs all over the district.

Writing in May, Mr. Ragg says: "In 1904 I had a splendid crop of pears. Last year for some reason, from some source unknown

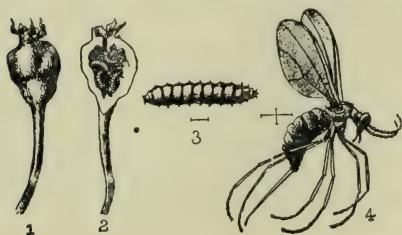


Fig. 8.
THE PEAR MIDGE.

1. Pear stunted and malformed by the larvæ within it. 2. Section of pear with larvæ. 3. Larva, much magnified. 4. Female fly, much magnified. Lines show natural length of fly and larva.

(From U.S.A. Dept. Agriculture).

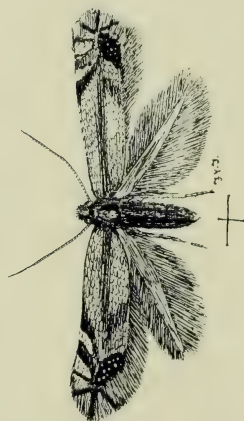
I had a bad attack of the midge and *kainit* did not wholly get rid of it, as I find I am likely to suffer this year. Consequently I am handpicking all pears out of arms' length, and keeping all those within reach under observation, destroying them when necessary. As I am afraid many of my neighbours have it, I should like to know how far they can fly? It appears this pest

has been enjoying itself in this neighbourhood for years, yet it seems that hardly a single gardener has heard of it. Wet weather, and so forth, had been taken to be a full and sufficient cause for the loss of the pears."

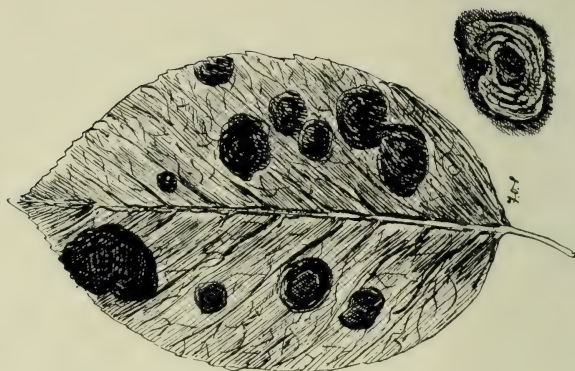
Writing on May 30th, Mr. Ragg says that he finds that the ravages of the Pear Midge cover almost the whole of the Borough of Reigate, and is also known in some of the outlying villages. In many large gardens, there is scarcely a sound pear.

On May 29th many grubs had already left the pears in this locality, but the place of observation was described as a sort of "sun trap." They were so plentiful that all early varieties were attacked, except one early old-fashioned kind, called the "Honey" pear. Beurre d'Anjou and Catillac suffered badly, Josephine de Malines rather badly, and a few Vicar of Winkfield. Comice

PLATE XVI.



THE PEAR LEAF BLISTER MOTH
(*Cemiosstoma scitella*),
and larva (greatly enlarged).



Pear Leaf showing mines of the Pear Leaf
Blister Moth larvae.

is rarely infested, and also Glou Morceau. Beurre Easter was the only other one Mr. Ragg found to be free from the midge.

There is no doubt that killing the blossom by concerted action over a wide area will get rid of this pest, as has been done in Canada ; this can be accomplished by a heavy arsenical spray when the blossom is out. It is well known that bees are killed by this. Cannot we attack it in another way ? A good lime-wash spraying undoubtedly puts back the bursting of the buds. Will it do so sufficiently to carry some varieties of pears, anyway over the fatal period, when the flies oviposit, for they will rarely do so in an open truss ?

This is being tried on a tree that is infested every year, and should it prove of any benefit, fuller advice will be given at once.

In the Western Counties and Midlands, where there is any Perry fruit, I fail to see that we can do anything. No one could possibly hope of fighting pests on the large Perry-pear trees seen in Herefordshire, Worcester and Somerset. So long as they remain so long will the pest continue ; but no one would dream of destroying them, so we must rely on Nature : a good late frost now and again to cut off the food supply of the midge.

The Pear Leaf Blister Moth (*Cemiosoma scitella* Zell.).

This moth was reported from Eardiston, Worcestershire where the larvae had so mined all the leaves of a large pear tree trained against a stable wall that they were quite blackened and dead in August.

Previous damage has been reported from Scotland and Cambridgeshire.

A full account of this insect was given in the Journal of the S.E. Agricultural College No. 8, pp. 21-31, 1899, to which the reader is referred.

H.—TO PLUM.

The Red Plum Maggot (*Opadial funebrana* Tr.).

It is some years since any complaint has reached me concerning this insect. It was reported in December from the Horticultural College, Swanley. The maggots must have done harm to the fresh

fruit, but the damage is difficult to detect, especially in damsons. They were complained about owing to their appearance in the damsons that had been bottled.

This is a somewhat serious matter that has not previously been paid any attention to.

One does not like finding these little caterpillars, as frequently happens in the West of England, in plum and damson tarts, and their presence in bottled fruits is just as bad and would materially lessen their market value.

It is a well known insect entomologically, but fruit growers seem to pay little attention to it. Stainton says, "In the caterpillar stage it is exceedingly plentiful in plum pies."

In 1894 it occurred in some numbers in plums at Kingston-on-Thames,* many larvae being obtained on August 15th. The plums were falling before they were quite ripe, one tree losing all the crop. On examining the fruit, a hole at the base of the plum near the stalk was noticeable, and on opening the fruit, the centre was seen to be damaged, and there was much wet "frass" together with the reddish-caterpillar. They are seen to live inside the plum around the stone, tunnelling here and there into the flesh.

Very frequently, in fact in the majority of cases, the fruit does not fall, and hence the larvae get bottled with the fruit and get into pies, etc.

Specimens were also received in 1894 from Headley, the maggots being found in their cocoons under the "shreds" used for nailing wall trees. It was also reported then as being very troublesome in some years in the Isle of Thanet.

Besides feeding on cultivated plums and damsons, it also feeds on the sloe and other wild prunes.

Life-history.

This is as follows:—The moth appears in June and July. The female places her egg at the base of the stalk, and in ten days the small caterpillar hatches, and at once enters the fruitlet.

The moth is about half-an-inch in wing expanse (6 to 6½ lines). The forewings are purplish-grey, clouded with smoky-grey; at the

* "Notes on Insect Pests in 1894," p. 8 (1905) F.V.T.

anal angle is an indistinct ocellated patch, edged with shiny pale grey and enclosing four black dots. Stainton describes the forewings as grey, clouded with smoky-grey. Mr. Farren, F.E.S., of Cambridge, told me that Stainton's description was probably drawn up from a faded specimen, and that his specimens were more purplish-grey, and this is certainly the case; some are much darker than others.

The larvae under observation at Kingston were all full grown the first week in September, but many matured in the end of August. The caterpillar is chestnut-red, the sides yellowish; others I have seen deep red all over, such as those received this year from Swanley. The head is dark brown and shiny; the first segment yellowish-brown; segments eight, nine, eleven and thirteen have each two lateral spots of a dark hue, and twelve a dark mark in the centre of the dorsum. There are three hairs on the side of each segment, except the last, which has many. Each segment is much wrinkled. The true legs pale brown; the pro-legs pale pinkish. Antennae of four segments, a bristle arises from the basal one and another from the base of the fourth and two small ones terminally. When full grown they measure about five-eighths of an inch.

The larvae, when they leave the fruit, seek shelter, such as under rough bark, *débris* on the ground, or as was recorded from Headley, under the shreds used for nailing wall trees.

In such-like places they spin cocoons of whitish silk, and remain as larvae all the winter, giving rise to amber-coloured pupae, dark-brown towards the posterior extremity. Kollar also refers to them as pupating under the bark.

Leaf Hoppers (*Typhlocybidæ*).

During the past year numerous cases of damage and annoyance caused by Leaf Hoppers or *Typhlocybidæ*, have been reported.

On August 6th, Mr. Wm. Chambers wrote from Southfleet concerning "certain insects infesting his plum trees."

On the 14th, he wrote again as follows:—

"These so-called Frog Hoppers, or Leaf Hoppers, have been so numerous that they were so constantly getting into the eyes, ears,

and mouths of the fruit pickers that they stopped picking. I washed for them several years ago and cleared the trees with soft soap and quassia; they all fell to the ground, and I thought I had made an end of them, but on the following day they were revived, and all up the trees again. They suck the moisture out of the leaves, and increase so enormously till one is afraid to go near the trees and disturb the myriads of them."

Mr. Fred Smith, of Loddington, tells me they suck the sap so much that they weaken the growth of the trees, and several others have referred to them in Kent.

A bad attack was observed and followed at Wye in all stages. At Ombersley, in Worcestershire, plums of all kinds were much damaged. They were equally abundant at Lynmouth, in North Devon.

The damage done by these Leaf Hoppers is very marked when they are present in great numbers; a few do little or no harm.

Three species were found to be the culprits, namely, the Oak-feeder (*Typhlocyba quercus* Fab.), and two yellowish Leaf Hoppers (*Chlorita flavescens* Fab. and *C. viridula* Fall.).

These insects, of which a full account is being published in the Journal of Economic Biology, all work in a similar way on Prunes and Apples. They feed by sucking the sap from the leaves on their under side. The result is that the leaves first become marked with pale areas, and later in many cases quite pale, presenting the general appearance of the so-called "Silver Leaf" disease. A similar effect is produced in apples. But on nuts the result is very different, the leaves become cut up with irregular ragged holes, due to the young leaves being punctured and the subsequent splitting of the wounds, very similar to that caused by the attack of earwigs in hops.

The two yellowish species lay small white spindle-shaped eggs, with distinct ribs on them, on the under sides of the leaves, and the young larvae and nymphs hibernate throughout the winter in any convenient shelter. The larvae are green and wingless, and feed on the under side of the leaves, cast their skins, and change in early summer into nymphs, which are also green or yellowish-green, and with distinct wing-buds, but they also do not fly. The

cast skins stick firmly to the leaves, and remain some time on them. The winged adults are yellowish-green, and are very active, running and jumping and flying with great agility.

They apparently feed mainly on fruit trees, nuts being especially attacked. The spotted Leaf Hopper *Typhlocyba quercus*, is smaller, and the front wings are beautifully marked with orange and red, and the tip with brown net-like ornamentation.

This last named insect feeds normally on the oak, but during the last season seems to have changed its habits suddenly, and attacked plums, apples and nuts. At Wye they certainly had not occurred on the latter for thirteen years, but had been abundant on oaks.

This spotted Leaf Hopper lays its eggs just under the lower skin of the leaves, one to four in number, placed side by side if more than one is laid. The larvae coming from them pass out of the leaf on the under side, and live there and change to nymphs.

Two broods or generations appeared during the year. The winter is passed in the larval and nymph stages frequently in company with the *Chloritae*. They hibernate in all manner of places, especially in Spruce and other Conifers in the neighbourhood, but also in rubbish at the foot of hedgerows, under moss and lichens on trees, etc.

All three of these leaf hoppers may also hibernate as adults.

Natural Enemies.

The specimens sent by Mr. Chambers were largely parasitised by some strange Hymenoptera, called *Proctotrupids*. These parasites lay their eggs in the bodies of the Typhlocybae, and the larva coming from the egg gradually forms a sac as large as the hosts' body, which projects from it, giving the abdomen a bifurcated appearance. This sac falls off, and the larva within matures, and the small Hymenopteron escapes to attack other Leaf Hoppers.

The effect of these parasites is not very marked, but they destroy the internal sexual organs of their host, and reduce the external genitalia to such an extent that a parasitised individual can be at once recognised even when the "animal gall" has fallen off. So great were the number of these parasites in both *Chloritae* and *Typhlocyba* sent by Mr. Chambers, that they must have nearly

stamped the insects out. None were found at Wye, but two *Typhlocybae* were caught in Worcestershire with these parasites in them.

They are also preyed upon by small fly maggots, belonging to the Pipunculid genus, *Atelenurus*. An *Eupsocus* was also found in great numbers with them, but what its economy is was not found out.

Treatment.

When these insects are seen in their immature stages, heavy washings with soft soap and paraffin kills them, and even soft soap and quassia, but no wash will kill the adults that will not seriously harm the trees.

The plan to follow is undoubtedly that employed in treating a similar pest in vines in America (*Typhlocyba comes*), namely, to get the insects on to the ground by a soft soap wash, just as described by Mr. Chambers, and then spray them when on the ground with a twenty-five per cent. paraffin emulsion.

The adults may also be caught by jarring them off the trees on to tarred boards or sheets.

The Oyster-shell Bark Louse (*Aspidiotus ostreaeformis*).

This scale insect or coccid appears to have increased lately in British plantations. During the past year a very badly infested plum tree was pointed out to me by Mr. Getting, of Ross, in his plantations, so badly encrusted that it was cut down and burnt. The scale was seen to have spread to some other trees around, and these were treated with all due care. The same scale was twice pointed out to me by growers in Worcestershire, and the same wise drastic treatment followed.

In Kent this insect occurs mainly in the Maidstone area ; Mr. F. Smith tells me it is of frequent occurrence in the plantations.

In February, another inquiry as to its nature, and specimens of immature females were sent from near Sittingbourne.

The scale covering the insect is often somewhat like a small native oyster shell, but it is subject to enormous variation in shape ; the young scale being almost round. The scale is flattened, smooth

PLATE XVII



THE OYSTER-SHELL BARK LOUSE (*Aspidiotus
ostreaeformis*) on Plum.

in texture, but shows concentric markings ; slightly out of the centre is a circular black spot.

Older scales become more elongate and irregular, and are greyer in colour, especially when they thickly encrust the trees, as seen in Plate xvii. They then produce a scurfy appearance, but when younger and round in form, they are scarcely noticeable, owing to their approximating the colour of the bark.

At times they are so flattened against the bark that they look almost like the rind. This was the case with the specimens sent from Sittingbourne.

The Oyster-shell Bark Louse attacks plums, apples, pears, apricots, nectarines and peaches. It has also been recorded on currants, near Maidstone, and elsewhere, and Newstead gives the Heaths as food plants. The latter great authority on this group of insects, says it "increases but slowly," but at times it seems to do otherwise, and trees are too frequently killed by it. It certainly spreads slowly, but from personal observations it seems that when once a tree is attacked, it is doomed unless some treatment is adopted.

Unlike the Mussel Scale, which is found in the egg stage under the "scale" during the winter, the Oyster-shell Bark Louse occurs in the immature female condition.

On lifting up one of the scales, say in February, one can easily remove with a pin a small yellow body beneath the scale. This is the female insect not yet mature. Winged males appear in April and early May, and fly around the scale-laden trees. The male is yellow with transparent wings, and a dusky band running across the thorax from the base of the wings.

The females are then fertilised, and numerous eggs are laid, which hatch into little active larvae that move over the tree. These soon settle down, and the scale commences to form over them.

Treatment.

This consists of spraying in winter with paraffin emulsion at the rate of seven gallons of paraffin to 100 gallons of water. But if a tree is badly infested, it is really best to cut it down and burn it. Any young stock showing signs of this scale should be fumigated in winter before being planted with hydrocyanic acid gas.

This gas will kill any scale insect, such as this one, but it will not affect these insects in the egg stage as we find the Mussel Scale during the winter. (Mr. Lounsbury tells me it will if strong enough.)

The Plum Aphis (*Aphis pruni* Reau.).

Complaints of this pest were received from the Whimple area in Devonshire, various Worcestershire and Kent localities. The general complaint has been that spraying does little good, owing to the leaves so soon curling up and thus protecting the aphides from the wash. Some experiments were conducted during the past summer to see if any benefit resulted by using (1) a very fine spray, and (2) on other trees a heavy washing.

There was no doubt as to which did the most good. Examination after spraying with a fine nozzle showed that where the mist *had penetrated* the curled leaves not enough fell on the aphides to affect them; many were not touched. In fact, it was almost entirely where the spray was put on for so long that dripping resulted, that any good was accomplished. The trees that were heavily washed showed much more dead aphis, the wash running into the curled leaves.

Spraying at this time is wasteful, and not successful.

The Plum Aphis hatches before the buds burst, and is seen as a dull, fat, purple mother-queen settled in the axil of a bud. This spring (1907) the eggs hatched on March 2nd. The young coming from the ova are dull olive green. By March 16th some had already attained the dull purple mother queen form, waiting to deposit their green lice. These aphides are easily destroyed by soft soap and quassia wash, and thus they are prevented from giving rise to the little green lice which at once cause the leaves as they unfold to curl up, and moreover, they attack the blossom.

One plum tree which had hundreds of the black ova between the buds was sprayed with lime and salt on February 27th. This has completely stopped the aphis from hatching. The unsprayed trees, and one branch protected on the lime washed tree are covered with aphids.

At present we do not know the life cycle of *Aphis pruni*; undoubtedly it leaves the plums later in the season, but where it goes to we do not know. I am inclined to believe to wild, umbelliferous plants.

The Mealy Plum Aphis (*Hyalopterus pruni* Fab.).

The Mealy Plum Aphis has not been of any account in Kent during the past year; in fact, it is never very obnoxious in the county. But in Worcestershire it was very abundant, and had there been any plum crop, it would materially have lessened the market value, judging from what I saw in the one locality where there were a few plums. It also caused some annoyance in Herefordshire, and was recorded once from North Devon.

This Aphis is quite distinct from the previous species and does not seem to do so much harm directly to the trees, for leaves keep green and sound when laden with these insects for some time. The great quantity of honey-dew they secrete falls on to the leaves below, and on to the fruit, and thus its obnoxious nature manifests itself.

The Mealy Aphis appears in July, usually the latter part, but last year they made their appearance early in the month. They continue increasing under the leaves until the end of August, and even into September.

They are easily told by their pale green colour, and the dense mealy secretion they become covered with. The honey-dew falling from them becomes a black, sticky mass, and this damages the leaves below them as well as the fruit.

In colour this Aphis is pale green with deeper green mottlings, and a dark median stripe, and is covered with white meal. They cluster close together under the leaves until a whole leaf is smothered by them. Then winged viviparous females are produced of a bright yellowish green with dark green markings on the thorax, and triangular ones on the abdomen, and with red eyes. They are covered with a certain amount of meal. These winged females fly from tree to tree.

In the early autumn they all disappear from the plums. Unfortunately, we do not know anything definite regarding the life-cycle. Walker stated that it is the same as the Aphis found on reeds, etc., known as *Hyalopterus arundinis*, and I am inclined to think the two are the same. I have never been able to detect any sexual generation on plums, and have always noticed that they suddenly disappear from the prunes in autumn. De Geer, however,

stated that he found this Aphis on an apricot and describes both winged male and wingless female, and that in September he found an egg with a woolly coat fixed near a leaf bud.

This may have taken place, but it is certainly not the usual habit. We may safely say that the Mealy Aphis comes to the prunes in summer and leaves them in early autumn.

It has also been found on the peach, and in Italy has been observed on grape vines.

It is usually worst on Victorias and Czars, but it may also occur on Pershores, Greengages and Damsons.

Treatment.

This consists of spraying with some wash having soft soap as a base. Frequent use and experiments have shown that it is most difficult to kill with ordinary paraffin emulsion, and almost impossible with quassia and soft soap. It has recently been clearly demonstrated by Mr. Getting that it can easily be destroyed by adding to the paraffin emulsion Liver of Sulphur at the rate of 1lb. to the 100 gallons of wash.

Experiments with a patent wash containing this ingredient were also completely successful.

I.—TO RASPBERRY.

A Ground Beetle in Scotland.

In November specimens of Ground Beetles were received, which were becoming very prevalent in the Raspberry Plantations of Blairgowrie, Scotland.

These beetles were said not to be doing any damage, but the number that occurred gave rise to grave apprehension. The species was the well known *Harpalus ruficornis*.

J.—TO STRAWBERRY.

Fruit Weevils. (*Otiorhynchus picipes*, etc.).

In May the so-called Raspberry Weevil (*Otiorhynchus picipes*) was reported as being very abundant in the strawberry lands in the

Cheddar district. In this locality it was not confining its attentions to strawberries only but it was attacking gooseberries and loganberries. In June other weevils were sent chiefly *Otiorhynchus tenebriosus*. This large black weevil was doing a lot of harm to strawberries at Rodney Stoke, near Cheddar, and the Raspberry Weevil (*Otiorhynchus picipes*) was at the same time said to be doing much damage to the grower's Loganberries.

The beetles, which have been fully dealt with in previous reports seem to become every year more and more omnivorous, for during the past year they have attacked garden plants and shrubs besides fruit and hops.

No washes have any effect, all that can be done is "jarring" and collecting the beetles. There seems to have been no previous record of them doing harm in the Cheddar district, but I gather they have been present for many years and have frequently done no little damage. Their attack on Loganberries is of particular interest, and of course to be expected.



Fig. 9.

Otiorhynchus
tenebriosus. x 3.

[The Black Anthonomus (*Anthonomus rubi*) Attacking the Strawberry.]

By G. FENOULHET, S.E.A.C. DIP.

During the summer of 1906 I noticed considerable damage done to the strawberry plants at Wye, and later at Penn in Buckinghamshire.

The damage done is two-fold. First there is a loss in the yield of fruit, and secondly the young shoots of the plant are checked. The cause of this damage I found to be a small black weevil.

This Weevil proves to be the *Anthonomus rubi*, which also has been found on raspberries and which normally feeds on bramble and roses.



Fig. 10.

Anthonomus rubi.

1, Beetles at work on Strawberry blossoms ; 2, Stages life-size ; 3, Larva ; 4, Pupa ; 5, Adult ; 6, Ichneumon parasite ; 7, Pupa in blossom ; 8, Damaged blossom.

Life-history.

About the latter half of May, when the strawberry blossoms were bursting into flower,—this weevil was very busy. It was to be seen running up the leaf and flower stems, and making its way to the flower buds. The weevil deposits its egg in the closed blossom, it then descends the flower stem to about an eighth of an inch below the bud, where it forces its rostrum into the delicate stem, severing through the vascular bundles.

The weevil treats numerous other buds in a similar manner, also descending to the base of the stem, where it punctures the delicate young leaves and stems situated there, sucking out the plant juice.

The buds attacked by the weevil soon show they have been tampered with, for in about two hours they droop from above the puncture. In a day or so, the bud will either fall to the ground, or remain on the flower stem in a shrivelled and brown condition.

At the expiration of a month the bud will be found to contain a footless grub, which pupates in the cavity it has formed. It remains in this stage from 7 to 8 days, at the end of this period a second generation of adult weevils is produced.

This generation of weevils, though the season is too advanced for them to do further damage to that year's crop, yet injure the young shoots and leaves by puncturing them.

Thus far the weevil has been traced ; as to whether the winter is tided over in the egg stage, or the pupal stage, is an uncertainty.

Description of Adult.

Black, unicolorous, clothed with distinct and evenly distributed, but scanty greyish pubescence, which is closer on the breast and thick on the scutellum ; eyes prominent ; head with a depression on the forehead ; rostrum long and slightly curved attached to which are the slender antennae ; the first segment of the funiculus is much longer than broad. Thorax broader at its base than its length, strongly narrowed in front and closely punctured elytra with strongly punctured striae, with interstices slightly convex. Legs elongate and fairly slender, black, with knees and tarsi pitchy ; all the femora with a small tooth. Claws of tarsi bifid. Length $2\frac{3}{4}$ to $3\frac{1}{2}$ mm.

Natural Enemies.

On examining several of the buds containing pupae many of the latter were found to have lost their insect-like form, and on keeping, Ichneumon flies appeared in the place of the weevils.

This natural enemy evidently serves as a partial check to the increase of the weevil.]

The Garden Swift Moth (*Hepialus lupulinus* Linn.).

Larvae of this moth were received in November which were destroying a "fine lot of strawberries at Ashton-under-Hill, near Tewkesbury," per Mr. Emptage. The same correspondent says he once had a lot of Spanish Iris destroyed by the same larvae.

The damage done by these ground caterpillars is a cause of frequent complaint. Fruit is especially attacked in gardens by them and many other plants; strawberries seem to be the only fruit plants seriously damaged by them.



Fig. 11.

THE GARDEN SWIFT MOTH.

The best plan so far has been to heavily broadcast soot between the rows in winter and work it well into the soil with prong hoes.

From some experiments made they seem to be too active for any naphthalene mixture to be affected by it. It works too slowly and the result is they come to the surface and work in the crowns of the plants if it is prong hoed in and pass deeper down if it is left on the surface. Where, as above reported, a very bad attack takes place in strawberries it might be well worth a trial to inject bisulphide of carbon between the rows. Some experiments are being made in connection with this and it is hoped some results may be reported next year.

The New Strawberry Aphis (*Siphonophora fragariella* Theobald).

This insect did not cause any bother near Ledbury in 1906. "It appears," writes Mr. Bickham, "in small quantities about the middle of April, chiefly on yearling plants and increases until about

the middle of May, but not enough to do the slightest harm, and suddenly disappears."

Further localities for this Aphis have been reported in Kent and Surrey, and it is probably widely distributed.

The Strawberry Aphis (*Siphonophora fragariae* Koch.).

A green aphid is frequently very obnoxious to strawberries grown under glass. Specimens of this Aphis were received from Mr. Oswald Ellis from Bramley, and an inquiry in regard to the treatment of pot strawberries attacked by this green fly was received from Dorsetshire.

The correspondent in the last named county wrote as follows:—

"I have soaked the plants in a patent mixture, but I still find any number of aphides. Can you tell me how to get rid of them?"

The same has been noticed with green fly upon Tulips. Some were treated this March with strong soft soap and quassia; the adults were seen to be dead. Next day there were lice on them again. These were washed with the same solution and the tulips were cleaned.

Experiments were then conducted with isolated females and it was found that though the females themselves were dead the young escaped from their bodies up to twelve hours after death. This is what probably happened with the strawberries. Two washings thus become necessary.

A Red Spider on Strawberries.

A communication concerning an attack of Red Spider on strawberries was received from Broadstone, Dorset, in January, and an inquiry sent in regard to treatment. The correspondent stated that "When housing the strawberries in December he dipped them in a weak solution of 'Tarbol,' but the treatment was not effective."

The presence of Red Spider on the strawberries had been constant and did considerable damage.

As no specimens were sent the exact species could not be told.

Dipping in a solution of liver of sulphur and soap was recommended, twice in succession, at about ten days interval.

INSECTS INJURIOUS TO VINES.

The Mealy Bugs (*Dactylopius longispinus* Targ-Tozz and *D. citri* Risso.) on Vines.

Numerous communications have been received concerning Mealy Bugs on various hothouse plants. One only needs be

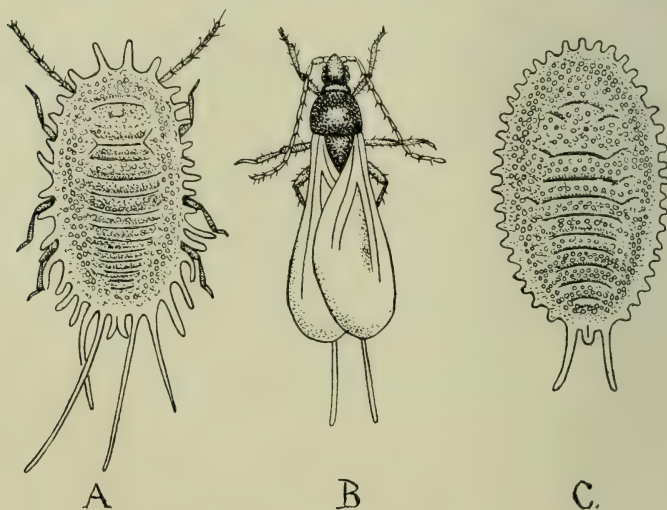


Fig. 12.

A. *Dactylopius longispinus* ; B. Male ; C. *D. citri*.

(After Newstead.)

mentioned here, namely an attack of these insects on vines at Bredon's Norton.

Fumigation was advised and carried out with great care by Miss May Crook, who kindly sends the following details :—

September 14th, 1906. Vinery—1,920 cubic feet. *Quantities used*: 2 ozs. potassium cyanide (98 per cent.) ; $1\frac{1}{2}$ ozs. fluid sulphuric acid, S.P.G. 184 ; 4 ozs. water. *Result*: Some Mealy-bug still living.

September 21st, 1906. *Same quantities. Results*: Mealy-bug all killed except in middle house where it was worst.

September 27th, 1906. *Quantities used* (in middle house only) : 3 ozs. Potassium cyanide (98 per cent.) ; $1\frac{1}{2}$ ozs. fluid sulphuric ; 4 ozs. water. *Result*: Mealy-bug all killed.

Scarcely a trace could be found in July, but one larva was detected.

GENERAL NOTES.

Greasebanding for Winter Moth.

The good effects produced by the plan of greasebanding fruit trees have been so marked that it is now becoming of general practice, and many enquiries are received concerning the best way of carrying out this simple preventive.

Winter Moth was not so prevalent as usual in Kent in 1906, but was complained of in Worcestershire where no banding had been done in cherry and apple plantations.

It must first be pointed out that it is only the wingless females and winged males of the Winter Moths (*Cheimatobia brumata*), the Mottled Umber Moth (*Hybernica defoliaria*) and the March Moth (*Anisopteryx aescularia*), that are caught by the bands. There is no evidence to show that Apple Blossom Weevil, etc., are caught in this way.

To be of most service the bands should be put close to the ground, not as seen in the figure, high up the trunk, as many females have been found to oviposit on the trunk itself. Secondly, the bands should be kept moist until March so as to catch the wingless females of the March Moth. In two or three years an orchard can be cleared of these pests, then the banding may cease for a time.

Beetle Mites (*Oribatidae*) on Fruit Trees.

These mites seem to be much on the increase in Kent; in nearly every orchard they occur in countless numbers.

Usually they occur on plums, damsons and pear. They were reported from Marden as occurring in masses under the bark of apple trees in November, and also from localities in the Maidstone area and in Thanet, also from near Malvern.

PLATE XVIII.



A GREASE-BANDED APPLE TREE.

The species which is the common one on fruit trees is *Oribata lapidaria*, so I am informed by Mr. Cecil Warburton, and not *Oribata orbicularis* as previously reported.

These Mites, as has been frequently mentioned, are not of an injurious nature.

During the past year some plum trees have been seen literally

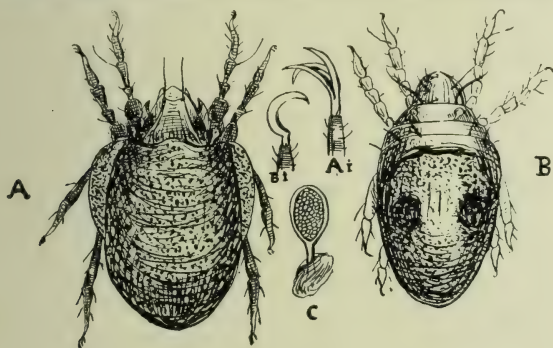


Fig. 13.

BEETLE MITES (*Oribatidae*).

A. Adult *Oribata lapidaria*; B. Nymph; C. Stigmatic organ.

Ai. and Bi., Ungues.

covered with them on the stem and larger boughs, none could be found on the foliage, and the trees remained perfectly healthy.

Hares and Rabbits Attacking Young Fruit Trees.

From Borden Hall an inquiry was received asking for any known substance to paint trees with to prevent the damage done by hares and rabbits eating the bark of the young trees.

Paraffin and soot had been tried, but it did not keep them away altogether. No information could be obtained concerning this important subject, and all growers asked said they knew nothing that would be of lasting effect.

Wiring young stock up to three feet is all that we can do as far as is at present known.

It is possible that lime, salt and sulphur wash might have some effect.

ANIMALS INJURIOUS TO CORN CROPS.

Purples or Ear-cockles in Wheat.

This disease in wheat has caused some considerable loss during the past year in three localities. The first case reported was early in September, when Mr. S. H. Garrad wrote from Bures, Suffolk, asking for an examination of the ears of wheat sent, as some thirty acres had been badly damaged.

About the same time an inquiry came from Bedfordshire, and in October the disease was reported from near Wye.

This disease is known as "black wheat," "ear cockles," and "peppercorns."

It is well known from Text Book references, but does not seem to be generally common. As it has been reported three times as being injurious during the past year, it has possibly been more abundant generally than in recent years.

The curiously formed blackish masses taking the place of the grains of wheat make the disease readily recognisable. These "galls," for they are nothing but galled wheat kernels, are at first dull purplish-brown, then become brown and then almost black. They are called in some books "ear-cockles," because they bear some resemblance to the seeds of that plant in form. The difference in shape is, however, most marked. Their great variation can be seen from the "galls" shown in the photo.

The specimens sent in many cases had every grain in the ear destroyed. Some ears were fully developed, a few only such as are shown were stunted.

The loss in two of the cases referred to must have been very great, as I believe the samples sent in both cases were taken at random. In Suffolk the disease was at first thought to be "smut."

PLATE XIX



PURPLES OR EAR-COCKLES.

Showing galled grains in ears, and detached.

This disease is due to an Eelworm known as *Tylenchus scandens* or *Tylenchus tritici*.

On cutting open one of the galled grains when quite fresh, it is seen to be filled with a whitish-yellow soft mass ; when dry, with a dry greyish mass.

The contents are minute eelworms, which when in the moist state are seen to be very active.

If the dried mass is placed in tepid water and kept warm the apparently shrivelled up worms regain vitality and assume the movements of those we saw in the fresh galls.

Time was not wasted in trying to unravel and count the number in any individual gall, but it must have been several thousands in some of the largest. It is said that these nematode worms will regain vitality on being moistened after passing twenty years in the dried condition. These worms are in the immature form. In length the mature male *Tylenchus scandens* reaches 2 mm., the female is much larger, reaching 5 mm.

It is said by the chief authority on this group of worms, Dr. Ritsema Bos, that the size depends on the size of the gall.

Life-history.

The worms found in the galled grains are in the immature stage.

These galled bodies I find readily fall from the ears when the wheat dries off, and in the movements of the sheaves, during carting many fall to the ground.

It is said and has also been well established this last season that many of the " ear-cockles " come away in the thrashed wheat.

This may escape detection and the grain be used for seed.

In either case the larvae escape from the gall into the earth and it is said that they can remain in it some years without developing. But where " galls " are sown with the seed the larvae escaping from the decayed gall at once make their way into the seedlings next them. They penetrate by means of the oral spine into the roots and between the sheathing leaf and haulm. They make their way even into the terminal bud. When the wheat blossoms the young worms quickly penetrate into the flowers and the ovary becoming invaded swells into a small bladder-like body, which gradually hardens, turns green, purple, brown and black, and so forms the galled grain.

The actual number of eelworms in each ovary varies, the lowest are said to have the most, varying from sixteen to twenty, the highest the least (some four to six).

As soon as these larval nematodes enter the ovary of the blossoms they become mature, and both males and females occur. The females deposit from 600 to 1,600 eggs each and from these ova develop the larvae found in such numbers.

Two things I have noticed different from the account given by the authority Ritsema Bos, (1) that very frequently the grains do not swell until the larvae are produced, and (2) that in the samples examined there were often more larvae in the grains near the top than those lower down.

In wheat there is only one brood or generation during the year, and the worms do not breed until they reach the ears, but in rye they apparently breed beforehand and the result is that the effects are much worse.

The disease can be detected early by the leaves becoming much crinkled at their edges. Ritsema Bos states that the haulm remains relatively short, this is *not* the case here, for some of the worst heads were on the longest straw.

Nevertheless we can usually detect the presence of the worms by the much crinkled edges of the leaves.

Treatment.

We have to deal with this pest in two ways (1) in the ground, from the fallen galls, (2) in seed corn.

The former is a difficult problem, but where we can plough deeply with a skim coulter it is possible that the galls may be buried so deeply that the young worms may be put out of harm's way. Judging from other Anguillulidae or Eelworms a good dressing of lime would be beneficial over the land particularly if it were deficient in it.

The second is easily remedied, namely, not to sow any infested corn.

It may be said that it is not easy to tell an infested sample. The galled grains can be easily seen, owing to their dark colour, and such should be discarded. But if not, owing to any particular value of the seed, it should be treated as described by Ritsema Bos

with weak sulphuric acid. The strength employed should be one pint in thirty-three gallons of water, the seed being soaked in it for twenty-four hours.

Most of the galls readily float and these can be easily skimmed off, those that remain have the eelworm larvae killed.

Wheat Midges (*Diplosis tritici* Kirby, *D. aurantiaca* Fab., etc.).

The disease known as "Red-Gum" in wheat has so far been entirely attributed to one species of Midge in this country, namely, *Diplosis tritici*.

Miss Ormerod referred to a second species as *Cecidomyia cerealis* attacking barley at Kingsnorth, near Ashford, Kent, but nothing further has been added. Exactly what *Cecidomyia cerealis* is I do not know, apparently it is some synonymous term for some other species, probably one of the two mentioned here.

Miss Ormerod, however, refers to this *cerealis* as attacking barley between the sheathing leaves and haulm.

The large red larvae and puparia were sent in February from Risboro, Bucks, where they had been very harmful.

From the Isle of Thanet samples of machine refuse were sent in January, and amongst this Wheat Midge puparia and larvae occurred in enormous numbers. Mr. Rothwell has found amongst them a third species which is much smaller than the true *Diplosis tritici*, but much the same colour.

The figure given by Miss Ormerod of the "Anchor-process" of *Diplosis tritici* does not appear to belong to that species at all, and probably she had confused up the various corn-feeding Diplosis.

The large red or vermillion puparia she apparently calls *cerealis*; these are *Diplosis aurantiaca*. An account of the three Wheat Midges will appear in the next report.

Fever Flies (*Bibio hortulanus* Linn.) in Oats.

During May an attack of the larvae of the Fever Fly (*Bibio hortulanus*) in oats was reported from Emstrey, Shrewsbury. Quite thirty were sent taken from a patch of soil four inches square, and there were also some pupae.

The larvae of these so-called Fever Flies are very similar in general form to small Leather Jackets, the grubs of the Daddy-Long-Legs. There is really no popular name for them; the term adopted "Fever Flies" was applied by Miss Ormerod to *Dilophus febrilis* Linn., which she recorded as swarming in hop cones at Rainham, in Kent.

There are several common species, but the only one I have ever had sent with notes as to their injuries is *Bibio hortulanus*. The grubs frequently occur in masses, and at other times spread out in the soil and feed off the young tender roots of plants, and even in the case of hops on thick roots in the hills.

The larvae live throughout the winter, and pupate in the early spring.

They have been sent from most parts of Britain, and from all manner of crops. Grass land is frequently affected by them; they are very harmful in gardens, frequently destroying beds of early lettuce, and as recorded above, cereals come in for a share of their obnoxious presence.

They were also received in February from Hampshire, where they were attacking hops and corn.

The Frit Fly (*Oscinis frit* Linn.).

Several applications for information concerning the Frit Fly (*Oscinis frit*) came during 1906 from Yorkshire. Near Hull and at Appleby it was very destructive to oats, and appeared to have occurred in large numbers in some fields.

It seems to be spread all over England, but so far I have been unable to obtain any information of its presence in Wales.

The Frit Fly appear to be generally common on grasses, from which it evidently invades the oats.

An account of the pest is given in the last Report (p. 66).

Thrips in Oats.

The so-called Black Fly (*Thrips cerealium*) was busy during 1906 in Oats and Barley. From Reigate samples of damaged Black Tartar Oat ears were received in September from Mr. A. Buss, which presented very peculiar and characteristic symptoms.

PLATE XX.



Damage done by *Thrips* in Oats (Note deformed straw).

These symptoms pointed to an attack of the small Hymenopterous *Isotoma*, but it proved on examination not to be so.

The presence of Thrips on Oats was noticed at Wye during the year, and in previous years, and the same effects as those shown in the sample sent were observed. The haulm just below the ear becomes deformed, as shown in the photograph reproduced here, in a very characteristic manner. At the same time, the little Thrips attack the grain while it is yet soft, and cause it to shrivel up. In this way the yield is much lessened and the heads of oats assume an unhealthy appearance. The whole mass becomes weakened, and bends downwards.

This "black fly" attacks, not only all kinds of cereals, but is to be found in abundance in wild grasses along the hedgerows, and at the headlands, and there is no doubt that corn crops become infested in this way.

Thrips move in large numbers during warm and sultry weather, and then settle upon the crops.

They at once commence to breed and the young Thrips or larvae, which are orange yellow, attack the blossom, maturing grain and haulm.

In the early part of the year, a few can frequently be found between the sheathing leaves and the haulm, there they remain sucking the sap and weakening the plant, and it is these early specimens that cause the damage to the haulm shown here.

The later arrivals mainly attack the blossoms and green kernels.

Where the larvae live, they change to the nymph stage, which is paler in colour than the larva, usually yellow. The winged form arises from these before the corn is ripe, and these fly away to grasses and get shaken on to the ground, where they feed upon what they can get amongst surface vegetation.

The adults are black and winged, about one-eighth of an inch long, the curious narrow fringed wings are best explained by reference to figure 15.

Treatment.

In cereals, this, of course, is out of the question, but we can do a good deal in preventing future attack by burning the hedge and headland refuse in the winter, and by scarifying the stubble

and collecting it and burning it, or else by deep ploughing bury it and the hibernating Thrips so deep that they cannot escape in the following year. The attack can never be stamped out owing to the "Black Fly" feeding on all manner of wild grasses, and their habit of occasional migrations in dull, sultry weather.

Nevertheless, these Thunder Flies may be materially lessened by winter destruction, and the keeping low of hedgerows, for it may always be noticed that attacks start along the side of fields against high hedges, probably because they afford more winter shelter, but it may also be that they have some effect in holding up the periodical migrations of these pests and thus whilst doing harm to one field form a protection for the next.

ANIMALS INJURIOUS TO ROOT CROPS.

The Pigmy Mangold Beetle (*Atomaria linearis* Stephens).

This Mangold pest has not been reported since the record in my First Report on Economic Zoology for the British Museum in 1904 (p. 8).

It has appeared, however, during the past year in at least three areas.

On June 9th the following communication was received from the Herefordshire County Council :—" The insects sent have cleared off a crop of mangolds at Much Marcle in this county. The field has been re-sown, and the second plant has now been practically cleared off. Most of the plants are eaten off about the surface of the ground. Very few of the insects are to be seen during the day, but at night they are numerous all over the plants. I have heard of other mangold fields in the district suffering, probably from the same pest, though in a less degree. I ought to mention that the field has been cropped with mangolds several years."

It has also again appeared at Wye, and near St. Neots. The insect has also been recorded as doing damage at Barnstaple in North Devon, at Lymington, at Denham in Buckinghamshire, Shrifnal in Shropshire, at Weston-super-Mare, and at Ashburton in Devon.

It occurs in Britain generally and does much damage to mangolds. The damage is very frequently attributed to other causes, and I have known the actual beetles taken to be ants.

The beetles destroy the sprouts of the mangold seeds as they germinate, and then as the plants grow they attack both the leaves and the roots. This is usually when the plants are just coming into leaf and when the cotyledons show up.

The damage done to the leaves is not apparently very serious, the beetles eating out small irregular holes in them. It is the damage below ground that is so fatal. The beetles not only destroy the sprout of the seed, but they attack the small tap root, eating

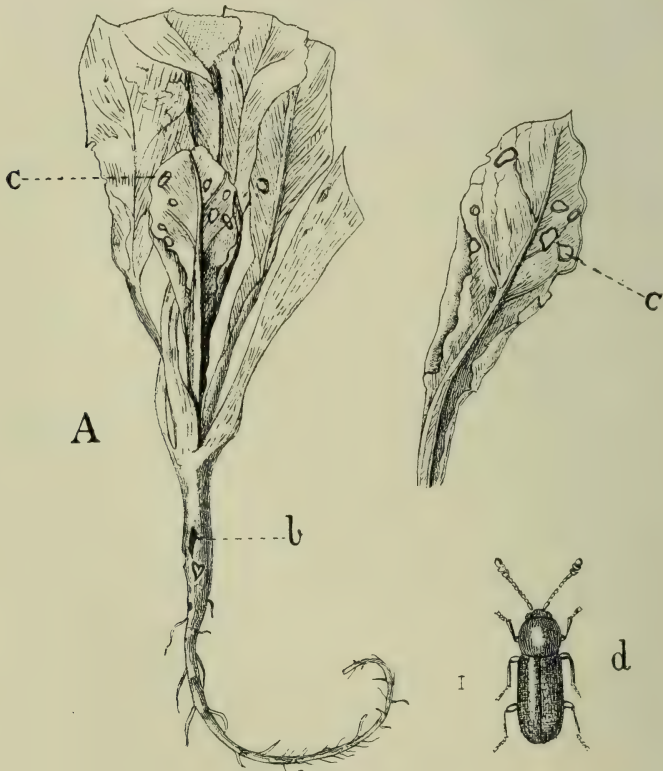


Fig. 14.

THE PIGMY MANGOLD BEETLE.

- A. Mangold plant, showing damage done by *Atomaria linearis* to root (b), and leaf (c) ; d. Adult beetle.

it in places, which appear to turn brown and then black, and show very marked signs depicted in the figure.

Thus all parts of the plant are attacked during its young stages.

The beetles are to be noticed in May and June. They are brown in colour, extremely agile in movement, and live both above and below ground, mainly the latter. In fact, they are most easily found by putting one's fingers under the seedling mangold and lifting it and the earth up and holding the whole still for a few seconds, when the beetles begin to crawl. At certain times one can always find them by pulling up the seedlings, the beetles holding on to the root. Their colour and their small size render them very difficult to see.

Although they have no real resemblance to an ant, they have often been thought to be small ants by growers, and have twice been sent me as such. During the past year an attacked crop was kept under observation, and no beetles could be found on the leaves at all. They continued until the end of July in the ground, and then gradually decreased. I have in previous years noticed them as late as August 17th.

Although M. Bazin observed it at Mesnil, St. Firmin, in 1839, and Macquart still later, devouring fields of red beet near Lille to such an extent that the fields had to be ploughed up, and Miss Ormerod has made some slight reference to it, and several attacks have come directly under my notice, nothing has yet been found out concerning its life-history.

I have been unable to get the beetles to oviposit in captivity, and have failed to trace the larval stage. Apparently it takes place in the ground. I have found the beetles hibernating in the winter and they may be found on the wing pairing in June on warm days.

It varies in length from 2 to 2.8 mm.

Treatment.

At Barnstable the crop was practically destroyed, just as was reported in 1906 in Herefordshire. Under such circumstances, deep ploughing at once is advisable. In districts on the Continent, where this beetle is destructive, the thick sowing of seed is practised in the cultivation of sugar beet, and would be worth doing in this country with mangolds. During the past year some experiments were conducted on the College Farm in connection with this pest. Part of the attacked crop was dusted with soot, another

same sized plot with lime, and the third sprayed with paraffin. The soil around the plants was hoed in soon after the application in the first and second, and the result soon showed in the case of soot, the beetles at once leaving off their campaign ; lime had little effect, and the paraffin the same. Judging from what I observed it seems that a heavy dressing of soot would be beneficial as checking the work of the beetles when the plants are young and there seems to be no damage done when the mangolds are in full leaf.

The Turnip Gall Weevil (*Ceutorhynchus sulcicollis* Gyll.).

This small weevil has been reported as being very serious during the past year throughout the Hundred of Hoo.

The damage seems to have been mainly to the turnip crop.

It is strange that no one seems to take any notice of this very harmful insect, and yet not only in the Hundred of Hoo, but all over the country it causes incalculable loss in turnips and swedes. It is said that when the galled roots are fed to sheep that it does not matter, it's all "fill belly" a shepherd will tell you! This may be so, and the maggots *may be* more nourishing than the root they live in, but when one gets no crop from the attack on young plants as seen in the photograph represented here, the importance of this insect to any farmer is at once apparent. I have seen fields of hundreds of acres which in October had only the roots just as shown in Plate XXI. ; this surely means a heavy loss. On Plate XXII. another root is shown from the Hundred of Hoo.

It is not so much the deformed, galled, necessarily stunted growth of the turnip or swede that is, however, of such vital importance : it is the too frequent attack on young plants when all future growth is stopped by these maggots that makes the Turnip Gall Weevil of such importance to the farmer.

Yet in spite of this having gone on for years, we find in the manual of that great authority, Miss Ormerod (p. 35), that "These galls do little harm in themselves, so far as turnips are concerned, —unless they are very numerous, or cause decay by wet lodging in the hollows of the galls from which the maggots have escaped."

Just previous to writing these notes, I have gone over a large bed of turnips, and find (February 20th), that those with the galls

PLATE XXI.



TURNIPS STUNTED BY THE GALL WEEVIL (*Ceutorhynchus sulcicollis*).

on them are just as sound as can be, small stunted masses, whilst many that have not been attacked are rotten from wet and frost. The loss from decay does not usually occur.

The harm is as Mr. English points out in the Hundred of Hoo, namely, the total loss caused by the attack on young roots.

Besides attacking turnips and swedes, it sometimes causes damage in cabbage of various kinds, but the damage done is not nearly as great as that caused in the former, and has frequently been the work of Cabbage Maggot, and not this pest at all.

Besides living on various cultivated Brassicae, I have found it in quantity on rape and mustard, on charlock and on a few other weeds. The chief food plants are, however, turnips and swedes, and to some extent cabbage, sprouts, savoy and kohlrabi. One report has been sent me of its presence on thousand headed kale.

Life-history, appearance and habits.

The parent of the maggot found in the gall is a small weevil known as the Root Gall Weevil (*Ceutorhynchus sulcicollis*). In size this beetle reaches about the eighth of an inch long; in colour it is almost black, with grey and almost white scales scattered over it, and these become dense below, giving it the curious mealy white appearance ventrally; the curved snout is dark, and bears two elbowed antennae; the thorax is marked by minute punctae or spots, and has a median groove or channel, and the wing-cases are marked by lines with intervening punctae.

The beetles hatch out very irregularly in the spring and early summer, and feed upon the nectar in the blossom of various brassicaous plants. The females bore a small hole in the root, and insert a single ovum in each hole. It is said that they lay their egg on the roots, but there do not seem to have been any observations actually made in this respect.

The maggot is pearly white, and scarcely noticeable when first hatched; it is footless and curved, with a brown head.

By degrees the grub causes a small millet-seed-like gall to appear over it, and this may swell up to the size of a hazel nut, in the centre of which in a round chamber, lies the maggot. When full grown the larva reaches one-fourth of an inch, and then eats its way

out of the gall and enters the soil. The length of life of the larva is very variable : it may take four weeks to mature, or it may take twelve or fourteen. The maggots may be found through the winter into the spring. This year I have found larvae not yet mature on February 20th, but only one here and there. The majority pass to the ground in October and November, a good many may still be found in December, and stragglers as late as March 20th.

On entering the ground the maggots make little earthen cases, made by mixing saliva with particles of earth and stony matter. These earthen cocoons are lined by a pale gummy layer, and lie in little cavities in the soil. The maggot then changes to a pale pupa within, and in the summer in two weeks the perfect beetle appears. In midsummer and up to September, the whole life cycle has been found to be about fifty days, in spring sixty, and in the late brood the larvae remain for many weeks developing very slowly. Those hatched from eggs laid in September pupated in February, and the beetles hatched in May.

Mr. English mentions that rooks are very fond of picking at the galls and taking the maggots.

Treatment.

Where a root crop has been attacked, the land should be deeply ploughed, well rolled, and no crop liable to attack put in directly afterwards. Many maggots are, of course, destroyed by feeding to sheep, but one must remember that by the time the roots are used, that many of the maggots, in fact the larger quantity have already passed to the earth.

One has frequently seen an infested crop that is too badly damaged to save, ploughed in ; this will not have any effect unless very deeply done. It is best to feed off all that there is by sheep, and then plough up.

Where cabbage is attacked it is most important that all the stalks or stumps should at once be burnt, or else the maggots will escape into the soil.

Some considerable benefit has been derived where cabbage has been attacked by a good dressing of gas lime. The quantity to use varies, but up to two tons to the acre has been safely employed spread on the surface, left for four or five weeks, and then ploughed

PLATE XXII.



TURNIP SHOWING GALLS OF THE GALL WEEVIL
(*Ceutorhynchus sulcicollis*).

in. In garden land the soil, where attack has been, should be deeply trenched, the top spit being deeply covered. With cabbages it is well to dibble in each plant with a handful of lime or soot, this to some extent acting as a preventive. It must be remembered that it is the attack on the young plant that is so harmful, although as we have seen, the older roots suffer. A good dressing of soot over turnip and swede crops soon after germination is also beneficial, but it must not be imagined that it will kill the pest: it merely wards off attack to some extent.

The main thing to aim at is to feed off all diseased roots, deep ploughing so as to well bury surface soil, and the avoidance of a succeeding crop liable to attack.

The importance of this is only too clear. Mr. English, writing again on February 19th, says: "Your theory that the insect is more injurious if the turnips are grown after green stuff is very easily seen here. We have a piece after collards and sprouting broccoli; they are most certainly the worst, and near by is a piece of turnips—after a bare fallow, which have very few bad amongst them."

Cut Worms Attacking Mangolds.

Mr. G. H. Grellier sends an account of an attack of Cut Worms on mangold roots on a farm near Epsom.

The larvae attacked the plants just as they were being set out.

The nuisance seems to be of some standing, and is chiefly noticed in dry weather. It was particularly bad in 1895.

The larvae attack mangolds in a very typical way, but which, however, is somewhat similar to the method adopted by the Ground Beetle (*Steropus madidus*).

They attack the roots in the young stage by eating around the root until it breaks off. In the case of older roots they eat into the root. The farmer stated that he had seen men collect on their farms half a pail full of the grubs.

They are recorded as killing many plants, and stunting the growth of many others.

Lime was found to have no effect upon them.

On the other hand a heavy dressing of soot had a very marked effect in checking the vitality of the caterpillars, and if soon followed by rain, I have found that great numbers of them become cachectic and die.

ANIMALS INJURIOUS TO PULSE.

Insect Blights on Beans.

Mr. R. H. Green, Monks Horton Park Estate Office, wrote in mid June asking for information concerning blight on field beans, and any method of combating the pests, which had been most harmful. In a later letter the three pests were fully mentioned, and they proved to be the Bean Aphis (*Aphis rumicis*), the Pea and Bean Weevil (*Sitones lineatus*), and Bean Rust.

The latter is not mentioned in this report except incidentally. The reason is that after years of observation, I have found that an attack of "Black Fly" or Aphis is so often followed by "Rust."

Whether there is any connection or not is for mycologists to decide, but that an attack of Aphis in beans is followed by Rust just as an attack of Woolly Aphis on Apples is followed by Canker is undoubtedly the case.

The difficulty in combating diseases in field crops is great. Remedies at once suggest themselves in many cases, but are they practicable is the first question. One is frequently inclined to say no, and not to recommend any remedy. The query above was such that one would not do so, yet the remedy was applied by self-help. Ninety per cent. of farmers if they had this treatment advised them would laugh.

Both insect pests named are common all over Britain, and do no end of harm, alike to field and garden crops.

Not only are beans attacked, but also peas, clover, lucerne, etc., by the Weevil, and occasionally the Black Aphis has been found on peas.

During a recent visit to Evesham, I also found *Siphonophora pisi*, Kalt., the Pea Aphis, on broad beans.

The Pea and Bean Weevils (*Sitones lineatus* Linn., and *S. crinitus* Herbst).

The damage done by these small weevils is mainly to the young beans and peas. The weevils eat the young tender leaves in very characteristic manner, and yet the damage they do is frequently attributed to sparrows. The pea and bean leaves are eaten out in more or less regular semi-circular pieces along the edge of the leaves, small areas only at first, then larger ones, until frequently they are devoured down to the mid-rib. Sparrows do damage to the young beans and peas, but one can easily tell the damage from that caused by the weevils, for the damaged leaves are ragged in appearance.

I have never noticed any real harm caused by weevils except to broad beans and peas, but other plants are attacked.

Not only are these *Sitones* injurious in the adult stage, but their larvae feed upon the roots of various plants, including those upon which the adults feed.

These insects are most harmful where the soil is rough and cloddy.

Life-history.

The beetles hibernate through the winter in all manner of shelter, and in spring are found flying about quite actively. They were observed last year as early as March 1st, and specimens have been taken in February from gorse blossom.

The commonest species is the Striped Pea Weevil (*Sitones lineatus*), which varies very much in size, from one-fifth to one-fourth of an inch.

The colour of fresh specimens is greyish to dull greyish-green above with darker lines; the thorax has four dark lines and three pale ones; the elytra have the lines thin and often inconspicuous, so much so that some specimens have them apparently unicolorous. This colouring is due to a scaly layer, the ground colour being dark, and thus old rubbed specimens are all dark in hue. The legs are grey, and the antennae ferruginous. Below, these beetles are uniformly clay coloured, earth coloured or grey. Thus when they fall on their backs as they are prone to do when frightened,

they are most difficult to see. When in the latter position they draw their legs in close to the body and feign death, remaining in this attitude for some minutes.

As they fall from the young beans at the least shock or jar, even of the earth, caused by anyone moving near, they frequently pass undetected, and the cause of damage is thus attributed to sparrows. One has to search carefully for them on the ground, or else look some way ahead up the row, and then they will be seen seated on the edge of the leaves on a warm day, feeding with great avidity.

In dull weather they are inactive and shelter under clods and in the folds of the young bean leaves. When they once get to a crop of beans or peas they lose much of their activity, but may be seen in numbers crawling about in copulâ.

They go on attacking the beans until they are some eight or ten inches high, and then we cease to notice them. Egg laying may commence in late May, and continues until the end of June.

The ova are placed on and under the soil, and the larvae feed upon the roots of the beans and peas.

The larvae are small white, footless grubs, somewhat curved, and when mature reach about one-fourth of an inch. They have been found on the roots of lettuce and other plants also in early summer.

Pupation then takes place in a little earthen cell some distance below the soil. The pupa is pale creamy, with darkened eyes and proboscis.

From these pupae a second brood of beetles makes its appearance. They occur mainly on clover, lucerne and sainfoin. These lay their eggs on the roots of the clovers, etc., and live there all the winter. It is these winter larvae that frequently cause clover to die off in patches, having a very similar appearance to the effects of *Fusicladium* and Eelworm attack in the same plant.

An examination of the roots alone will show the true cause. These larvae mature in April and May, and beetles appear from the pupae at the end of the latter month and in June. These augment the hibernators referred to previously. In a few cases this brood has come forth in March, but I have only known this to occur once. The fresh hatched specimens can at once be told

from the hibernators by their brighter colour, the latter often being quite dark.

It seems that a very favourite place of hibernation for the adults is barley stubble, but this is not their usual place of abode. Hedge-rows, heaps of rubbish, under the bark of trees, hollow stems, and such like are their usual winter quarters.

Whether the beetles feed upon gorse and broom in the early spring or go there for shelter we do not know, but where either of these plants occur they frequent them very largely, and from observations made at Guestling, in 1885, I feel inclined to believe that they go to the gorse to feed upon the nectar in the blossom, for many were observed feeding in the yellow flowers. I could never detect them eating the needles of this strange Papilionaceous plant.

The Spotted Pea and Bean Weevil (*Sitones crinitus*), does not do the amount of harm caused by the former species. It is certainly local, and no personal observations have been made on it. It is said to be particularly prevalent in the London district and on the South Coast, and appears to be very partial to tares. It can be told at once by its spotted wing-cases, and by its often chalky appearance, but at times it is reddish and often of an almost metallic hue when fresh.

Two other weevils now and then occur with the former, namely, *S. humeralis* Stephens and *S. hispidulus* Fabricius, but there seems to be no record of them on beans.

Treatment.

In the field the best check to give them is rolling when the land is suitable with a light wooden roller, so as to press down the soil around the young plants and break up the clods. There is no doubt that rough land helps them, for the beetles find congenial shelter in cold, windy weather around and under the clods. The rolling should be followed by a heavy dusting with soot.

Where, as has been described, great numbers are seen in the carts during barley harvest, these might be well collected and destroyed, brushed into pails of hot lime or in some such way to kill them.

Summer fallowing after an attack has been found beneficial.

But for beans and peas in the field there is no doubt that light rolling and a heavy dressing of soot is the most practical remedy. Where clover ley is found to be infested, deep ploughing with a skim coulter and then rolling would be advisable.

In gardens, sprinkling fine soil from hothouses over the rows of beans and peas keeps the beetles away, and even sprayings with paraffin emulsion are followed with much benefit.

The Bean Aphis or Collier (*Aphis rumicis* Linn.).

This black aphis, often called the "Collier" or Black Blight, is most harmful to broad beans in the field and also in the garden. It is, however, of most importance in the field, and not infrequently it means a total loss of the crop.

In Huntingdonshire I have recently seen a twenty acre field ruined, not a bean being formed; hundreds of applications have been received for information concerning this pest.

From nearly all counties in England and Wales, and from one or two localities in Scotland, complaints have reached me of its damage.

A warm year seems to favour them, but what accounts for the sudden and rapid increase of this aphis at certain times and under very diverse conditions of climate, as yet remains an enigma. There is no doubt that climatic conditions alone do not account for these phenomena, for fields have been destroyed alike in warm, dry and cold, humid weather.

It is not only the actual sucking or sapping of the juices of the bean that causes such loss: it is more by the excessive quantity of very gummy honey-dew that they excrete, falling on the pods and leaves, covering them so thickly with a putrid mass and stopping all respiration, that kills the plants.

At certain times the rate of increase becomes so rapid that the heads of the beans become blackened masses in a few days after infection.

So thick do the aphides become, that winged broods are soon formed and fly to the nearest unaffected plants, and so the wave of life sweeps over the field until all the plants are smothered by the "Colliers." It is essentially a broad bean pest, but I have seen it on other cultivated legumes.

The fact that it is found on a great variety of plants has been the cause of its being known under at least ten different scientific names, according to Buckton. Walker mentions as many as twenty-seven. I am sure several other supposed distinct species are the Bean Aphis.

Its chief food plants seem to be the various kinds of Docks (*Rumex*). Buckton in his Monograph of British Aphides, Vol. II., (p. 83), says its chief food plant seems to be the curled dock (*Rumex crispus*), but I have found it just as abundant on the others that are common, especially the Broad Dock (*R. obtusifolius*) and the Red Veined Dock (*R. sanguineus*), on Thistles, especially the Spear Thistle (*Carduus lanceolatus*), the Marsh Thistle (*Carduus palustris*), the Creeping Thistle (*Carduus arvensis*), and the Meadow Thistle (*Carduus pratensis*). The latter I have found frequently smothered with this black fly.

Buckton records that in 1854 its ravages in turnip fields in Yorkshire were very marked, "many hundred acres being utterly ruined."

It also occurs on rhubarb, ivy, holly, teasle, various polygonum, the foxglove, borage, marigolds, salsify, nasturtium, and frequently on the gorse. The main food plants are nevertheless the docks, and the thistles.

That this aphid flies to the beans is a well known fact. Its life-history is as far as I have been able to trace, a very complicated affair, and what so far has been traced is recorded here with the hope that it may help others in filling in the too numerous gaps.

Life-history and description of forms.

This Aphis is best known in the wingless viviparous stage. In this condition it is black, with the antennae black and dull yellow, and yellowish bases to the tibiae; sometimes the whole tibial segments are the same colour. There is much variation in this stage, some being covered with a slaty-coloured meal; others are quite shiny. The young they produce are always dull leaden grey, and then become velvety black, like some of the adults; others become shiny, or with a grey mealy coat. This is the stage we notice on the broad beans, and these viviparous females keep on producing young in great quantities. When the heads become crowded, some of them, often the whole colony, enter the pupal stage.

The pupa is slaty-grey on the head and thorax, black wing cases, black abdomen with four downy white spots, and two near the apex and a row on each side.

From these, winged viviparous females arise, the pupae having cast their skins. The winged female is shiny black; the tibiae and middle of the antennae yellow. The wings are iridescent, and short, and the costa and stigma green, the veins dull brown. There is much variation in colour, some being browner; others have brownish green antennae and cornicles.

These winged females fly to other beans, and later fly to docks and thistles, and there they start producing living young again and often smother these plants, occurring right through the summer.

In the autumn oviparous females are produced, which are wingless, and at the same time winged males, which are dark blackish-brown.

The females deposit their eggs on the stalks of the docks close to the ground, and probably also on the thistles. Where gorse occurs they generally fly to it towards the end of the season and produce the sexual brood there, the eggs being laid often in great numbers at the bases of the needles. Walker first observed this in 1846, and it has been several times noticed since, but if there is no gorse in the neighbourhood they do not leave the docks and thistles, but oviposit there.

There are several aphides very close to *A. rumicis*, and it is not improbable that they are the same.

The complicated life-history, and the still further complications that may and probably will be shown, their varied food plants and indefinite migratory habits, makes prevention almost impossible.

Prevention and Treatment.

There is no doubt, in spite of what is written above, that some good may be done by keeping down docks and thistles in the immediate neighbourhood of bean fields and gardens.

Treatment is the thing we must aim at, and it must commence directly the first signs appear. Spraying with soft soap and lots of quassia will soon stop the attack.

Some minor experiments have been conducted during the past year in destroying this Black Blight. One row was dusted with soot, another with an equal mixture of soot and lime, a third had the tops picked, and the fourth was sprayed. Those rows which were topped, were not bothered with aphid, and produced finer pods; the row sprayed was soon cleared of the Aphid; the two rows dusted continued to be infested, but showed less damage than the untreated rows.

In a garden where good pods are required, "topping" does double good, and undoubtedly this is to be recommended instead of spraying, but in field cultivation a good spraying with soft soap 5lbs., quassia 10lbs. to 100 gallons of water would be best. Two sprayings will generally be found necessary. The wash must also be put on heavily. Mr. Green sprayed the beans with knapsack sprayers and cleaned them. If the cost was somewhat heavy, it is surely better than losing the whole crop, as too frequently happens.

One further point in connection with the "Collier." In all cases where the "Collier" has taken up its abode, even in normal numbers, I have noticed that the beans suffer severely from "Rust." It is probable that the Aphid not only weakens the plant, and so makes it susceptible to this fungus, but that the aphides may carry the spores of the fungus themselves from bean to bean. It is thus doubly necessary that we should destroy it in the field.

The Pea Aphid (*Siphonophora pisi* Kalt.).

This green Aphid, so harmful to peas, in the field and garden, was found in 1906 in August feeding in numbers on the broad bean, near Evesham, in Worcestershire. This somewhat unusual habit is referred to here as a matter of interest.

This species can at once be told from the Collier by its larger, slenderer appearance, and its bright green hue.

The Pea Midge (*Diplosis pisi* Kaltenbach).

Reference was made to this pest in the last Report (p. 84). Although unrecorded as a British insect by entomologists, it has been known for very many years to gardeners and writers in horti-

cultural journals and books. In 1905 it was reported from several parts of Britain as being decidedly harmful to all manner of peas, especially Marrowfats.

A curious gouty or swollen form is assumed by the attacked pods, which are usually much shortened, but which still bear a few peas.

The maggots do not destroy the peas that mature, but feed in great numbers in the pod, apparently on the inner part of the shuck, and thus produce the deformity mentioned.

They are also obnoxious on account of their getting amongst the shelled peas for market, and thus lessening their value, and unless very carefully washed under a stream of water with some force, many get served up at table.

As many as three hundred of the little white maggots may be found in one pod, which becomes a seething mass of life, very repulsive to look at, but more usually I found from twenty to forty.

In Kent last year it was very plentiful, and I am told by various gardeners that they have frequently noticed the pest, but it had never before come under personal observation. It was also complained of at Ombersley, in Worcestershire.

The attack must not be confused with that of the so-called "Pea Maggot," the larva of the small mouse-coloured moth known as *Grapholitha pisana*, which eats into the green peas, and which can at once be told by the legs on its under surface, whilst the Pea Midge Maggot is quite footless.

The loss caused by the Midge is sometimes very great owing to the stunting of the pod, and so loss of crop and also the reduction in market value of what is gathered. Early peas do not seem to be attacked, the main crop peas suffering most. I have never seen it in dwarf peas such as William Hurst, nor have I yet found it in field peas.

Description of the adult and larva.

The adult is a small midge of delicate structure, which in the male when alive has a pale yellowish tint, with darker bands on the abdomen; soon after death it becomes dusky yellowish-brown.

When alive the male has pale yellowish antennae, and mouth parts, also part of the head; the antennae are darker at the apex

and are composed of twenty-four segments, the verticillate hairs being shiny in life. The thorax is brownish-yellow, sometimes very pale; pectus and pleurae dusky; the abdomen is yellowish with narrow dark bands and greyish hairs.

The wings are transparent, but dusky, with dark costa; the first long vein does not reach quite the middle of the costa; the second reaches the apex of the wing where it is curved downwards; the third bends downwards, its branches somewhat pallid. The legs dusky with yellow bases and under side, and base of the femora, and have some hairs on the femora and tibiae. Length, 1.8 to 2.0 mm.

The female has antennae composed of twelve segments. The abdomen is pale yellowish, with black hairs with dark bands broadened in the middle and a long extensile yellow ovipositor. The legs dark blackish brown. Length, 2 to 2.5 mm.

It seems, as far as I could find, that the females lay their eggs soon after the young pod is formed, passing out many at one time in a single pod by means of the extensile egg tube.

From these ova hatch small white maggots, which, when mature, measure up to 3 mm. in length. They are sometimes of a pale, creamy colour, and the brown anchor process is very prominent, and its shape at once identifies it.

When mature, these maggots escape from the pods and fall to the ground. They, like all *Diplosis* larvae, have the power of hopping or skipping, and thus get to the ground by springing from the outside of the pods when they split.

They then enter the puparium stage, which is grey to pale brown, and those kept did not hatch until the following June. Taschenberg, however, says that in four weeks they become mature insects, which live through the winter. Winnertz hatched them in July. It is thus possibly two brooded, although I failed to obtain more than one in the year, and I feel sure that it spends the winter in the puparian stage in the soil.

Treatment.

This is extremely difficult, but it is advisable to burn all infected plants as soon as what crop can be gathered is in. The deformed pods left on will crack in time unless this is done, and the larvae will pass to the soil.

Land where this attack has been, should be deeply trenched, rolled, and only top worked in the following spring.



Fig. 15.

THE PEA THRIPS (*Thrips pisivora*).
(Greatly enlarged.)

Pea Thrips (*Thrips pisivora*).

This pest was bad in parts of Kent, Surrey, Essex and Worcestershire during 1906. A correspondent writing from Reigate stated that all his main crop had been destroyed, and that his fellow gardeners around were suffering from the same thing. "It is a serious matter, as I am afraid I shall not have any peas to pick in a few days. It seems to attack them just as they are about to flower. Duke of Albany, Exhibition Marrowfat, William the First, and Bountiful, all equally attacked."

Great numbers of peas were seen destroyed by this "Thrips" or "Black Fly" in Worcestershire in July.

The treatment with tobacco wash and soft soap, and by lighting smoke fires or smudges near the rows, so the smoke drifts through them, have both again proved successful, but must be done in time. If the Thrips are allowed to increase in great numbers the damage is done so rapidly to the blossom, and later the pods, that no treatment can make up for the loss they have occasioned.

ANIMALS INJURIOUS TO HOPS.

Eelworm Disease, or Nettle-head in Hops (*Heterodera schachtii*).

This curious disease, also known as "Skinkly" Plants, found in hops, was first attributed to Eelworms by Professor John Percival (*Journal of the South-Eastern Agricultural College*, No. 1, p. 5, 1875). Since his discovery, this has become a well established fact. The disease does not seem to be so very serious as was at one time anticipated, yet it nevertheless is very persistent where it occurs, so much so that the affected stocks may be said to be doomed. It spreads but slowly.

Mr. J. H. W. Best, of Suckley, Worcestershire, wrote in August that for some years he had noticed "Many of the stocks in his Colegates looked as if they were going wild: little early leaves and no growth. This year a patch or two in the 'Fuggles' adjoining were affected."

A similar attack took place at Mr. Partridge's, near Newnham, in the same county, in August, but a few stocks only were affected.

It thus appears that this disease is not limited, as was at first thought, to Kent, and I hear that it has been observed in Herefordshire. There is no doubt that the best plan is to dig up and burn any stock showing this disease, and to disinfect the land with a heavy dressing of lime and salt where the stock has been lifted.

In one or two instances, the hops have regained their normal health by heavy dressings of lime.

"Nettle-head" is mostly seen in old gardens, and little or no injury results till some five or six years after planting.

Practically all varieties of hops are attacked, but according to Professor Percival, the early kinds suffered most.

As this matter is very important owing to the infectious nature of the disease, through infected soil, and the great importance of destroying diseased plants and cleaning the hills, Professor Percival's paper is here reproduced, as the first copy of the *Journal* has long been out of print.

SYMPTOMS.

A.—Above ground.

The bine in the early part of the season is seen to be weakly in growth, but it is generally not until the end of June that unmistakable signs of the disease are apparent. About this date most of the affected plants leave the pole and the heads fall over. The toppling over may occur almost suddenly after the bine is well developed and the hops in "burr," or the bine may never reach higher than four feet up the pole. The leaves are smaller in size than usual and their edges curl upwards; in bad cases they remain very small and shrunk, giving the impression that the plant is suffering from dryness or want of water supply to its roots. Often they show a peculiar bluish-green—sometimes yellowish-green—colour, which is strikingly different from that of a healthy plant. On looking at a leaf held up with its upper surface towards the light, narrow thin transparent patches are visible alongside the veins, even before the curling of the edges begins, and the veins themselves appear drawn together where they branch from one another.

The parts of the stems between the nodes or joints are short and thin, and these peculiarities, together with the remarkable curling of the edges of the leaves, so alter the appearance of the shoots that they resemble those of the ordinary stinging nettle.

The complaint is "catching," or infectious, and when a badly diseased specimen is noticed in the hop-garden, others will be seen almost invariably in the immediate neighbourhood. The illness spreads more and more every year if no attempt is made to stop it.

B.—Underground.

Dig carefully about eighteen inches or two feet away from an affected hill and examine the roots. The finer delicate rootlets are found to be thicker and more stunted than those of healthy plants. On taking away the soil very gently, in June or July, small white bodies about the size of a pin's head or less are seen to be attached to them. Later in the season these bodies change to a brown or chestnut colour, and a magnifying glass reveals small injured places along the rootlets in the form of thin slits through the skin.

Localities with a light loamy soil show the worst cases, and it is in such places that the ailment spreads most quickly. Although plants once affected invariably grow worse and worse, and the yield of hops is greatly reduced, in some seasons the plants partially recover their vitality, and a fair crop may be obtained.

Cause.

The cause of the disease is a very minute eelworm known as the Beet eelworm (*Heterodera schachtii*) which lives in the young delicate rootlets of the hop plant, and there feeds upon the juices or sap.

The small white or chestnut coloured bodies which on digging are found attached to the rootlets, are the female eelworms. They are lemon-shaped—very small—about $\frac{1}{25}$ th part of an inch long, and are always attached to the rootlets, their heads being buried in the latter and their bodies exposed. They are easily pulled off the plant and on examination with a microscope, after slight crushing, each female is seen to contain about 300 eggs. The development or hatching of these goes on while they are in the body of the female, and eggs and fully formed young eelworms (larvae) are often found together in the same parent. The young eelworms ultimately leave the cavity in which they have grown and wander out into the soil and into the tender rootlets. By means of a small needle-like piercer they possess in the mouth, they soon bore their way into the rootlet again, generally only a little way from the place where the parent was attached. After burying themselves beneath the skin of the rootlet they settle down, feed and grow into the completely formed sexes, male and female. During this growth they increase to such a size that the skin of the plant is torn into narrow slits and the bodies of the females become exposed as the whitish points mentioned above. The males fertilise the females and the latter then give rise to young eelworms as before. Although each single eelworm can do but little damage by itself the breeding process is such a prolific one and goes on so quickly (from egg to complete female with several hundreds of eggs within it, every four weeks or thereabouts) that the enormous number soon completely ruin the most delicate and most necessary machinery of the plant, namely, the young absorbing rootlets. Not only is the rootlet slit and injured in hundreds of parts, but its nourishment is largely used up by the worms for their growth; there is also some evidence that the whole plant is injured by poisonous substances secreted by the parasites.

Although I have not been able to discover any intrinsic difference between the ordinary form as met with upon the sugar beet and oats on the Continent, it is worthy of note that the form upon the hop root is new, and remarkable in being not more than half the size of the species hitherto met with upon the roots of its common host, the sugar-beet plant, and is smaller than Liebacher's variety upon the bean and the pea.

The stem-eelworm (*Tylenchus devastatrix*) is met with on the thicker roots of diseased hop plants, but the exact part played by this parasite has still to be settled.*

Prevention and Remedies.

Although, at present, no practical method is known whereby the eelworms can be eradicated completely from a soil in which they have once established

* This eelworm may be found in any decaying roots, and has no connection with this disease. It has frequently been found in damaged hop roots showing no signs of nettle-head. (F.V.T.)

themselves, yet, wherever possible, the following methods of treatment should be adopted, in order to lessen the destructiveness of the attacks :—

1. At the first sign of the disease in the garden, dig up the plant and burn it on the spot. Much harm is done by delay, as, if neglected, the disease may soon spread beyond control. In the grubbing of old gardens that have been destroyed by disease, it is best to burn the rootstocks, and all the collected rootlets in the field, rather than attempt to get rid of them in any other way. The heating of the ground in such a case will, undoubtedly, free it from many of the parasites.

2. As much of the disease is spread by carrying the eelworms from one hill to another in cultivating operations, never use in healthy gardens, implements that have been employed among nettle-headed hops, without first carefully cleaning them.

3. Avoid planting sets from an infected locality. The young rootlets upon which the parasites are always found cannot be removed entirely from the sets, as many of them grow in the decaying back of the thicker parts of the root, nor can the parasites upon these be satisfactorily destroyed, even by dipping the whole set in poisonous liquids.

4. After grubbing a diseased garden, hops should not be planted there again for at least three or four years, and then only after growing special crops which the eelworms do not readily attack, as potatoes and leguminous crops. The ground may be used for cherry or apple orchards, but no cereal or cruciferous crop (turnip, cabbage, mustard, etc.) should be grown, since these harbour the pest.

5. It is little use to apply poisonous liquids to the soil round the affected plants, as these would certainly injure the delicate roots of the hops, the eelworms also are protected in the body cavity of the female, and are only free in the ground for a comparatively short time. Moreover, the cost of the amount of liquid necessary to saturate the ground even to the extent of one per cent, makes such a plan impracticable.

Lime, however, if applied at the rate of half a ton per acre is good in affected gardens, both on account of its deleterious action upon the eelworms and its good action upon the soil and the hop plant. Top dressings of muriate or sulphate of potash, three cwt. per acre, are beneficial in both tending to destroy the parasites, and at the same time acting as a food substance for manure for the plant.

JOHN PERCIVAL.

Millepedes (*Blanjulus pulchellus*) in Hops.

Of far more importance as enemies of hops than is usually attributed to them are Millepedes.

Three roots were received in July from Mr. John Bargent, of Alton, Hampshire, with the note that they had been stunted from some cause, and that some centipede seemed to be the cause.

PLATE XXIII.



A.



B.

[F. Edenden.]

THE HOP MOULD CECID.

A. Male ; B. Female.

The roots were received through the Secretary of the Farnham, Alton and Districts Hop Growers' and Farmers' Co-operative Association.

They were found to be swarming with the small Millepede (*Blanjulus pulchellus*).

All stages, from egg nests to adults, were found in the earth, and in crevices in the stocks. This small millepede is often found in numbers in many roots, but in recent years it certainly seems to have increased in hops, and in some cases traced in Kent, has been more harmful than wireworm.

Dry dressings of soot and lime, about two parts of the latter to one of the former, have given undoubted beneficial results, lime especially seeming to have a detrimental effect upon them. It may be pointed out that these snake-millepedes may be trapped in the same way as wireworm, by pieces of wurzel, carrot or beetroot put in the hills. This is a troublesome process, however. Injections of bi-sulphide of carbon in the soil seem to have had as good a result as has taken place with wireworms; unfortunately, its effects depend upon the humidity of the soil, and this accounts for frequent failures.

These small millepedes eat the rootlets and gnaw the larger roots of the hops and set up decay, where they have caused any serious damage. They work right through the winter just as wireworms do, and are especially ravenous in the spring, just when the hops are shooting up.

As far as last year's cursory observations went, they breed mainly in the late summer and autumn.

The Hop Mould Midge (*Cecidomyia* sp.).

It is not at all infrequent to find numerous small *Cecidomyia* larvæ breeding on various moulds, mildews and rusts. Two species at least feed on the rusts on cereals and grasses, another distinct form occurs amongst the Powdery Mildew of the apple and one is quite frequent amongst Hop-mould. These larvæ feed upon the mycelium and spores of the fungi, and may be watched browsing upon them, and clearing them away in patches.

The good they do, however, as natural checks, is very slight as far as can be judged from personal observations.

The species feeding on hop mould was first pointed out to me by Mr. Howard, then botanist to the South-Eastern Agricultural College, in 1903. The larvae were found first in September, but more recently in August.

One or more may occur in each spot of mould, and sometimes the entire area of the fungus was cleared off by them. Whether they then crawled to a fresh spot of fungus or not could not be decided, but as they could move on the surface of the leaf it is very probably the case.

The larva is pale in colour, about 2mm. long, with rather elongate, thin, anchor process which is expanded apically deeply notched in the middle, the side areas being rounded.

The larvae pupated in September, some on the 10th, and continued to do so until 30th.

Previous to pupation they entered the soil. The puparium being semi-translucent.

The first flies hatched out on the 9th of October, and paired readily, and continued to hatch until the end of the month.

Description of Adult.

♀ Thorax brown, abdomen yellowish-pink with long pale hairs. Antennae blackish with dusky hairs, basal segment bright yellow. Wings iridescent with long black hairs; the first long vein joining the costa just before the middle of the wing, the second just below the apex; the third nearly straight, the fourth running close to the third for more than half its length, and then where the transverse vein joins it to the third, bends widely down to the inner border of the wing. Halteres with dusky knob and grey stem, the former with black, the latter with grey hairs. Legs brown with black hair except the coxae which are reddish-yellow and the fore femora which have two blood-red spots, one of these apical. Length 1.5 to 1.8 mm.

♂ Very similar to the female; antennae of 24 segments. Length 1.5 mm. Details of the male were not taken from life.

PLATE XXIV.



[F. Edenden.]

CLUB OR KNOT-ROOT IN TOMATOES, CAUSED BY EELWORMS
(*Heterodera radicicola*).

ANIMALS INJURIOUS TO VEGETABLES.

Club-Root or Knot-Root in Tomatoes.

There seems to have been a large amount of the Eelworm, forming so-called Club-root in tomatoes, during 1906. One of the worst specimens seen came from Solihull, near Birmingham. It is reproduced here (Plate xxiv.).

This disease, caused by Eelworm (*Heterodera radicum* Kuhn.), has been spreading very much in recent years. At first it was thought to be confined to glasshouses, but it is now known to be found out of doors as well. The disease is popularly called "Root-knot" as well as "Club-root."

Cucumbers and tomatoes are particularly attacked in this country. Mr. Collinge also reports vegetable marrows being infested.

If the finer roots of drooping plants showing yellowish foliage are examined, they are frequently found to be studded with small nodules, and these can be traced up to all sizes, as shown in the figure, until thick masses are formed on the larger roots. The examination of the attacked parts soon reveals the presence of the lemon-shaped females and eel-shaped males, and the long eel-like nematodes and the larvae are also to be found in the soil.

The worms live deep within the roots and rootlets. The swelling bodies of the females and accompanying males frequently cause no abnormal spot in the plant root. An attack reported in turnips showed a few minute irregular swellings and dense masses of irregular fine root fibres. The galls are formed more by collections of the Eelworms, and are actual thickenings in the root, not lateral appendages, such as we find in leguminous plants. The male is a minute eel-shaped worm, about one-twentieth of an inch long. Eggs are laid by the lemon-shaped female in great

numbers, and are from three-thousandths to four-thousandths of an inch in length. The larvae are about twelve-thousandths of an inch, and are eel-like in form, and have a distinct oral, boring spine.

The worms, if becoming males, undergo changes in the old skin, and then break loose from it and become mature. If females, they gradually swell into the lemon-shaped form, and these are fertilised by the eel-like males. All stages can be found in a galled growth, and reproduction and consecutive fertilisation takes place in the tissue. Numbers also pass into the ground, and copulation may take place there. Fresh invasion by larvae takes place in young rootlets, and so new galled areas are set up.

It attacks a great variety of plants in different parts of the world, especially clovers and lucerne, but with us, tomatoes and cucumbers are the worst to suffer from its ravages, and potatoes, vines, peaches, etc., suffer to some extent.

The only thing that can be done is to destroy the eelworms in infected soil; this may be done by saturating it with carbolic (one part to every twenty of water).

But the soil must not be used for four weeks at least after.

When it occurs badly in a house it is best to remove all soil and clean the house well down with carbolic, one part in six of water.

Soil may also be treated with gas lime, but I am doubtful as to its benefit.

The mixing of naphthalene with infected soil has given best results; one part of naphthalene to twenty of soot has had most beneficial results.

All diseased plants, of course, should be burnt. Kuhn's trap plant system is very important, but wants much further working out in detail in this country before anything definite can be advised.

The Asparagus Beetle (*Crioceris asparagi* Linn.).

Considerable damage has been reported to have been done by this beetle in several parts of Britain during last year.

Mr. Gerald Fox writes me it does some considerable harm to the asparagus beds in his gardens at Hythe, near Southampton. Several other correspondents have written saying the same. A long

PLATE XXV.



LARVAE OF THE ASPARAGUS BEETLE (*Crioceris asparagi*).

PLATE XXVI.



EGGS OF THE ASPARAGUS BEETLE (*Crioceris asparagi*).
(Twice natural size.)

paper has appeared on this beetle in the Journal of the South-Eastern Agricultural College, No. 9, April, 1900, p. 21, so that no further reference need be made; the matter is recorded merely to show that certain people appreciate the great damage done in asparagus beds by this beetle, which is not apparent until the following year. Little or no harm is done here, as in America, to the harvest crop of shoots, but the check given to the plant for the following year by the larvae and beetles devouring the epidermis of the fronds, and so checking proper development and loss of seed, is most important.

Spraying with arsenate of lead seems to have given more satisfactory results than any other method of treatment.

Cutworms in Celery.

Specimens of celery with the centres of the plants eaten out were received from Barnard's Castle in December. The note sent showed that it was quite a new attack, celery having been grown by the grower under similar conditions for the last fifteen years. More or less all the heads in the plantation had been attacked in a similar way.

As far as could be judged the damage was due almost entirely to cutworms or the caterpillars of Noctuid Moth, especially *Agrotis segetis* and *Agrotis exclamatoris*.

A similar damage was traced to these larvae some twelve years ago near Albury in Surrey.

The Rosy Rustic (*Hydraecia micacea* Fab.) Attacking Tomatoes.

The larvae of this moth, which is common in parts of Britain, were found to be attacking the green fruits of the tomato at Bow, in North Devonshire. Mr. Emptage informs me that he had



Fig. 16.

THE ASPARAGUS BEETLE
(*Crioceris asparagi*).
(x. 3).

similar larvae sent him last year from Essex doing the same damage to the tomatoes. The caterpillars first appeared in June, and were found in greatest numbers near the doors and ventilators left open during the hot weather. The same three houses that were affected in 1906 were affected in 1905.

The houses were cropped with strawberries and tomatoes.

A caterpillar was sent as late as August 17th.

It has also been recorded as attacking Potatoes.* In this case the larvae tunnelled up the stems and completely hollowed them out, thus killing the haulm.

These caterpillars feed on a variety of plants, such as docks, valerians, equisetums, etc. When mature, specimens sent from

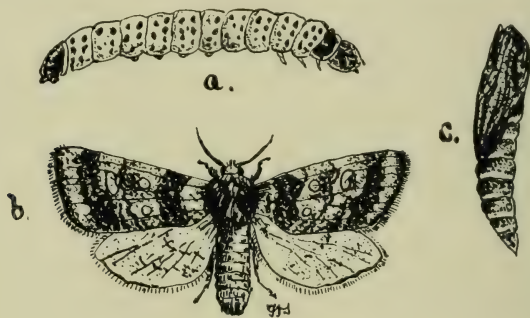


Fig. 17.

THE BURDOCK MOTH (*Gortyna flavago*).

a. Larva ; b. Imago ; c. Pupa.

Devon reached an inch and a quarter, but they often become somewhat longer.

The back and sides are dull purplish brown, paler on the first three segments and where the segments join, sides and venter of a dull flesh colour, legs pale and head yellowish-brown, on the second segment is a brown semi-circular plate broadly margined in front with blackish-brown and a shiny yellowish brown patch on the anal segment with a posterior border of small dark warts ; on the segments are small dark-brown tubercular warts each with a fine

* First Report on Economic Zoology for the British Museum, p. 81, 1903. (F.V.T.)

terminal hair ; spiracles deep brown and the forelegs pale with black extremities.

Before pupation the larva becomes paler, dull smoky flesh colour all over, with a dusky median dorsal line.

The full fed stage is reached from the beginning of July until as we see, from what is recorded here, the middle of August.

When attacking potatoes they were watched at work and were found to tunnel rapidly, as much as eight inches being tunnelled in an hour. In the tomato it is noticed that they also eat into the fruit. The larvae were also sent me as early as May 10th in docks. Stainton says it feeds on the roots of Cyperacea. Buckler quotes a letter received from the present Lord Walsingham, then the Hon. Thomas de Grey, as follows :—" I first observed the larva by pulling up, on the 14th of May, a sickly looking plant of *Equisetum arvense*. It appeared to be feeding on the root and stem below the surface of the ground, but when placed in a bottle with a supply of the food plant, it immediately entered a stem and fed upon the inner substance."

This is very much like what happens with *Hydraecia* (*Gortyna*) *immanis* in Canada, the larva of this moth is found in the hop growing districts of Ontario and the young larva bores into the leading shoot and causes distortion, called "bull-head." It then drops to the ground and attacks the plants at the collar just beneath the surface, the so-called "collar worm." The *Hydraecia nitela* of America, also attacks tomatoes, potatoes, spinach, and various other plants in a similar way and also feeds on leaves.*

When mature the larvae of the Rosy Rustic, recorded here as a Tomato pest, pass to the ground and pupate in an earthen cell. The pupa is pale yellowish brown in colour, about three-fourths of an inch long and has some thick bristles on the last two segments.

The moths have hatched out in Kent in September, but I have taken them "at light" from August to the end of September. It is common in gardens, lanes, hedgerows, and in fens or marshes. Great numbers were found in September on some marshy land near Scarborough in 1891. They may frequently be seen flying against lighted windows in the autumn.

* Some Insects Injurious to Vegetable Crops, Bull, 33, Div. Ent. U.S. Dep. Agri. F. H. Chittenden.

The adult moth has the forewings pale brownish with a rosy tinge, a broad darker patch below the upper border between the inner line and the elbowed line, whilst the hind wings are greyish-white with a darker central line. The wing expanse varies from one and a quarter to one and a half inches.

The larvae of the Frosted Orange or Burdock Moth (*Gortyna flavago*) has also been recorded as attacking the stems of tomatoes. An account of this species is given in No. 9 of the South Eastern Agricultural College Journal, p. 42, 1900.

In all cases it is well to keep a look out for any signs of wilting in tomatoes, both out of doors and indoors, also with potatoes, and destroy the attacked haulm at once, as from observation made it seems the caterpillars will attack several plants. The attack on tomato fruit is quite new to this country. It resembles the attack of the Cotton Worm (*Heliothis obsoleta*) recorded by Fuller * attacking the tomato fruit in Natal. This insect is, however, rare in Britain, but the similarity of the attack is worth noting.

The Cabbage Root Fly (*Phorbia brassicae* Bouche.).

Early in June this pest was sent from the Isle of Grain, Rochester, with the following note, "I am sending you by this post swede turnip roots, as to which I should be glad if you could give me any advice or information.

"Nearly the whole crop of seed turnips seems to be similarly affected, they rot off just below the ground. Strong and healthy plants seem to be attacked as readily as weak ones. On cutting up the roots I notice numbers of a white insect as well, of course, as wireworm."

Writing on the 28th, the correspondent says, "It is a strange fact that although I grew the plants in the same field and under



Fig. 18.

THE CABBAGE ROOT FLY
(*Phorbia brassicae*).

* First Report of the Government Entomologist, Natal, 1899-1900, p. 62.

similar conditions last season I have one piece about ten acres, very good and the larger piece of about fifteen acres is equally bad. They are two different kinds of swedes, the fifteen acre lot is purple, the other green top. But why such a difference? The fifteen acres was heavily manured last winter, the other field had grown a crop of mangel seed after being manured, and both lots of plants appeared quite healthy when planted out."

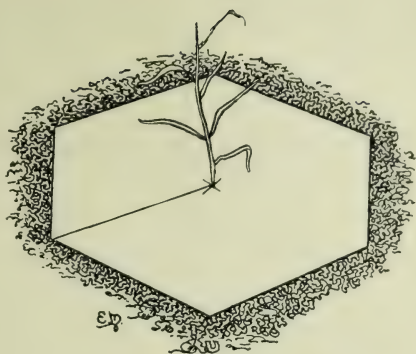


Fig. 19.

Method of preventing the Cabbage Root Maggot by "card discs."

This pest has been referred to before in these reports and needs no further notice, but a later attack of Turnip Gall Weevil in the same region recorded here may be read in connection with this.

The larvae of the Cabbage Root Fly have also been found on several occasions during the past year in plants suffering from Club Root. This latter disease, due to *Plasmodiophora brassicae*, causes considerable loss. The two diseases seem to be confused by some growers. This is probably due to the fact of the dipterous larvae having been found in the large deformed roots. Needless to say there is no connection between the two. Millepedes are just as frequent as the Maggots in Club-rooted Cabbages. The importance of discarding young plants showing any abnormal growths cannot be overestimated.

ANIMALS INJURIOUS TO FLOWERS.

Enchytraeus Worms.

These worms are now becoming a cause of incessant complaint. During the past year several correspondents have sent them wanting to know if they are eelworms, etc., and how to destroy them. The Rev. George Glover, of St. Leonards-on-Sea, who sent them on account of their occurring in such numbers in beds of pansies, etc., in his garden, traced their source of origin to heaps of leaf mould and road refuse.

There is no doubt that in this way these noxious worms are carried to gardens. In consequence it was decided to try some experiments to destroy them in heaps of leaf mould.

Experimentally injections of bisulphide of carbon proved successful, but as will be seen by Mr. Glover's notes this did not prove as satisfactory in the open as in the laboratory.

In May Mr. Glover wrote as follows :—Many are dead but there are still many alive, probably the great heap of half-decayed leaves sheltered the creatures. What surprised me was that two $\frac{1}{2}$ -oz. bottles failed to kill all the worms in an oval vessel 2 feet by $1\frac{1}{2}$ feet, the stuff was all sifted so that there was no cover for the worms. However, to-day we have looked in vain for any, so we seem to have got that good result." In consequence of this substance not proving satisfactory, various other things were tried, and all that proved of any avail was mixing infested leaves and soil with a heavy dressing of chloride of lime.

Mr. Emptage also sent numbers of these worms, saying that "some growers found them to greatly damage asters, cucumbers, and tomato plants."

They were also recorded from the roots of a large cherry tree that had died in Kent.

These all proved to be the so-called Aster Worm (*Euchytraeus agricola* Friend), which seems omnivorous as far as roots of plants are concerned.

Further experiments were made in connection with trying to clean leaf mould, etc., of these vegetal parasites but no remedy has been found; a very large number were killed by the use of chloride of lime, and so far all that can be recommended is this substance. The mould was mixed up with a fair sprinkling of the chloride and left, and scarcely any worms were seen after. Pot experiments showed the worms to be dead, but in the open some certainly escaped the effects of this disinfectant.

Roses attacked by a Sawfly (*Blennocampa pusilla* Klug.).

The rolling up of the edges of wild rose leaves is by no means an unusual sight. The effect is produced by the larvae of a sawfly known as *Blennocampa pusilla*. The presence of this insect on cultivated roses is however rare.

A bad case was reported from Hazel Grove, Stockport, last July. The disease is prevalent more or less throughout the district.

Others were reported from Somerset and one from Kent.

The attack is very marked, the leaves being rolled downwards on each side. This is mainly accomplished by the larvae, and as far as I can see it is the immature sawfly larvae that produce this effect alone. Cameron, however, states that they are aided by the incision made by the female when laying her eggs. The deformity produced in the leaves varies, in some the leaves are rolled into a variety of shapes, always of a cylindrical form. Others show both sides of the leaves rolled up irregularly, some only one side. The rolled leaves form a nidus for one or more larvae, and when they are destroyed, the larvae move to others and produce similar deformities.

In wild roses it is not at all unusual to see the whole bush entirely deformed in this way. I have noticed that in cultivated roses the worst attacks have been where suckers have been allowed to grow and the attack has started there. At the same time I have seen and had reported previous to last year roses kept in good state literally covered with rolled leaves, both teas and hybrids. The larvae are found at work in June, July, and

into the beginning of August. The adults occurred during the past year early in June, but they have been found in May.

The mature Sawfly is black and shiny ; the legs are black with whitish knees, tibiae and tarsi and the wings dusky iridescent. In length they are about one-sixth of an inch.

The eggs are laid on the leaf. The larvae are all green, the junction of the segments being paler, there are conspicuous hairs on the dorsum ; the legs are green darker apically, and the prolegs paler than the body. The skin in the last stages becomes somewhat wrinkled. The head is white and brown and very shiny, the jaws being dark coloured. Those kept under observation pupated or rather went to earth in August and remained as larvae in fragile cocoons until February and March, when they pupated ; some few remained until April.

This is a well-known rose insect, which not only occurs in Britain generally, but also in Sweden, France, Hungary, Russia, Holland, and Germany.

There is no doubt that where it occurs in numbers as it has done at Stockport, that it does much damage by checking the growth of the roses. It may easily be introduced into a garden with the earth adhering to the roots of briars and should be at once checked if seen, or it may spread and do no little damage.

In fact, judging from what we already know, it might be advisable to well wash the roots of briars previous to planting, to clean them of any of the hibernating larvae that may be within the earth particles attached to them.

A Sawfly (*Macrophya punctum album* Linn.) Damaging Privet.

The Privet is seldom damaged by insects. The Privet Hawk Moth (*Sphinx ligustri*) is sometimes sufficiently abundant to cause noticeable defoliation, but no other insect has been referred to as far as I can find.

Early in July small sawfly larvae were received from Swanley. They were eating very ravenously the epidermis of the leaves, and causing them to shrivel up.

The correspondent stated that they had only appeared in the garden two years ago, and had since been a great nuisance. These proved to be the larvae of *Macrophya punctum album* Linnaeus

(also known as *Tenthredo punctum* Fab.; *Tenthredo erythropus* Schr.; *Allanthus punctus* Ste.; *Macrophya punctum* Thoms.) The larvae are green in colour and feed also on the leaves of the Ash.

Little is known of this insect. It is stated in Cameron to be found in the London districts. Mr. Smith says "scarce, but once plentiful on a hedge of privet," also near Dover, Glanvilles Wootton, Devonshire, and also on Privet at Norwich.

References are made to it by Kaltenbach. It occurs in Scandinavia, Pomerania, Poland, Hungary, South Germany, Holland, Switzerland, France, Italy, and Spain.

The Sawfly is shiny black with yellowish white marks on the thorax; the black abdomen has white lateral spots and one on the last segment in the female, whilst in the male it is all black.

The legs are variable, the first two pairs are dark with pale areas; hind femora almost red, the tibiae with a broad apical white band.

Length, one-fourth to one-third of an inch. The larvae pupated in parchment-like cocoons between dead privet leaves in the breeding box. Probably they normally enter the ground.

Treatment.

Where privet hedges are as badly attacked as in the case reported they might be sprayed with a hellebore-wash composed of four ounces of fresh ground hellebore, six of flour, to ten gallons of water.

The Scarlet Tiger Moth (*Arctica caja* Fab.).

The so-called Woolly-Bear" caterpillars, the larvae of the Scarlet Tiger Moth (*Arctica caja*) were sent on the 1st of June with a complaint that they were destroying the leaves of zonal pelargoniums at Blackheath.

This beautiful moth normally feeds in the caterpillar—so-called "Woolly-bear"—stage on nettles and docks.

But many other plants serve as food for them, especially geraniums, strawberries, and lettuce.

The caterpillars live throughout the winter and may be found from October to the beginning of June. It is widely spread, occurring from Cornwall up to Scotland. It is seldom sent as an

enemy, but it undoubtedly does no little damage in the garden, especially in beds of geraniums when planted out early in the West of England, and it has several times before been notified as doing harm in greenhouses.

Surface Larvae Attacking Chrysanthemums.

In October specimens of surface larvae belonging to the species *Agrotis segetis* and *Agrotis exclamationis* were received, which had been very harmful to chrysanthemums grown in the open, especially attacking the variety *nircus*.

The caterpillars worked just above and just below ground, clearing off the bark and in this way appear to have done enormous damage.

An Ivy Pest (*Tortrix forsterana* Fabricius).*

Late in May a communication was received from Barnsley, Yorkshire, concerning a disease in ivy.

One corner of the garden was devastated by caterpillars, the ivy growing freely over a rockery and a wall reaching or abutting it.

The larvae were identified as those of *Tortrix forsterana* Fabricius. In the middle of June pupae were sent and a note at the same time stating that the caterpillars were still to be found.

The damage was very marked, the leaves being skeletonised in patches, turning brown and dying off in consequence. This *Tortrix* is recorded as being common in the South of England, and it also appears to be so in the North, at Barnsley, to such an extent as to become a serious nuisance. Morris and others record it from Yorkshire. The moth appears in June and July. In size it varies from a little under to a little over an inch in expanse of wings. The front wings are pale slaty or brownish grey, somewhat reticulated with a darker colour, with two dark costal spots, and a larger one in the inner border, the hind wings are slightly paler than the fore, and are darkened at the edge. The larvae are found in March and April according to Stainton, but as seen by the above note they occur as late as the middle of June. They all pupated by that time, and those sent me hatched out during the first week in July, and one as late as August 7th.

* Also known as *Tortrix adjunctana* Tr., D.L., and as *Tortrix reticulana* Fröl. (non. Hb.).

Besides feeding on ivy, the larvae are also said to use the honeysuckle as a food plant, and many other plants are now and then chosen by it.

They pupated in curled leaves.

Treatment recommended was heavy spraying with arsenate of lead and the collection of the curled leaves before the moths escaped.

The Iris Leaf Miner (*Agromyza iraeos* Dur.)

An interesting attack of fly larvae was reported in October, the specimens sent were "from a bed of *Iris gigantea* at a trade grower's place near Sydenham, who complains that the plants are getting in a weaker state each year." The leaves sent showed that they were very badly attacked with leaf miners. All this iris in the district were reported to be in the same condition. Not only the leaves but the sheaths were found to be full of puparia. Later the correspondent wrote that he had looked over the iris in the neighbourhood and could not find any on *Iris germanica*, and that it seemed to be entirely confined to *Iris gigantea* and *Iris foetidissima*. No trace could be found of it in the common yellow iris.

Hardy refers to this *Agromyza* in the Proceedings of the Berwickshire Naturalists' Society as attacking *Iris pseudacorus*. The flies commenced hatching out on March 18th, and continued to do so until going to press.

Iris Attacked by Leather Jackets.

Another iris attack seems to have been general during the past year. From Reigate Mr. Noble wrote in June, "I am sending some maggots which I find in every Iris; the plants are dying in numbers."

Another correspondent sent the same from Beckenham, and others were received from Kingston and Wye.

Two species of *Tipulidae* or Daddy Long Legs were bred out, namely, *Tipula oleracea*—the common Crane Fly and still more numerous, the Yellow Spotted Crane Fly (*Pachyrhina maculosa*).

These grubs eat the roots and set up decay, the leaves turn yellow and die, next season stunted leaves only occur, and the succeeding year the iris die right down.

One part of naphthalene to ten of ash or road dust worked in around the roots was found to destroy the Leather Jackets if a good dressing was applied, and well hoed in. Bisulphide of carbon injections of half an ounce to each plant had a still better effect.

Scale Insects (*Orthesia insignis* Douglas) on Nerines.

Specimens of scale attack on Nerines were received from Blackheath in June from Mr. Max Putsch.

The leaves were found to be covered with the curious scale insects known as *Orthesia insignis* Douglas, sometimes called the "Kew Bug" in this country, well known as the "Latana Bug" in Ceylon. The first record of this insect in Britain seems to have been in August, 1887, at Kew Gardens, on a Chinese plant *Strobilanthes*, which had been at Kew then three years and the scale had spread to other plants in an adjoining house.

Mr. Newstead and Mr. Ernest Green found it still existing there in 1896.

It apparently came over in 1886 on *Strobilanthes flaccidifolius* from Hong Kong, but the plant was not much infested, on the other hand two Indian species introduced by means of seeds received in 1887, were much subject to it, as are other *Strobilanthes* from India and Ceylon.

It was said to be the least harmful of all the parasites on plants at Kew, and according to the Report * issued by the Kew authorities, had been noticed in the tropical house for about ten years, but the source could not be traced. In this report it is said that "As far as Kew is concerned the *Orthesia* is rather a scientific curiosity than a pest."

This account may apply to Kew, but in other houses it is a very serious pest. Mr. Buckton, quoted by Newstead,† says of this insect, "it appears to be spreading over the hothouses of England and seems to be very difficult to annihilate. It does as much mischief as the more common mealy bug."

This is certainly correct. It has been referred to me for information from many quarters. At the Swanley Horticultural College glass-houses it was seen in numbers some two years ago, but has

* Bull. Roy. Gardens, Kew. Nos. 103, 103, p. 103 (1895).

† Monograph of the Coccidae of the British Isles. vol. ii. p. 239.

PLATE XXVII.



THE ROSE APHIS (*Siphonophora rosarum*).

since been cleared out. It attacked salvias and gardenias. It seems to have a very wide list of food plants which, according to Mr. Ernest Green, include the following orders:—Rubiaceae, Verbenaceae, Compositae, Solanaceae, Acanthaceae, Labiatae, Rutaceae, Leguminosae, Caprifoliaceae, Bignoniaceae, Rosaceae, Amaranthaceae, Terustromiaceae, Convolvulaceae, and Lythraceae.

It is widely distributed, occurring in the West Indies, Mexico, Brazil, British Guiana, China, Ceylon, Mauritius, South Africa, and the United States.

It does not appear to occur in Europe outside the British Isles.

Mrs. M. E. Fernald, in her Catalogue of the Coccidae of the World, p. 35, gives the following food plants:—coleus, latana, ipomoea, thunbergia, strobilanthus, verbena, achillea, salvia, cuphea, capsicum, ageratum, vernonia, gardenia, chrysanthemum, lonicera, various species of citrus, teaplant, strawberry, tomato, etc.

A full account of this serious pest which has been recently introduced into this country can be found in Mr. Newstead's able monograph or Mr. E. Green's great work on the Coccidae of Ceylon.

Although the pest is difficult to destroy by old methods, it is easily cleared out of a house by fumigation with hydrocyanic acid gas, and may be checked to some extent with dilute kerosene emulsion, but there is no doubt that the former is by far the most successful treatment.

Rose Aphides.

A request from Newbury for information concerning Rose Aphides was received in October, *via* the Royal Horticultural Society, especially in connection with their migratory habits.

There are three well-known Rose Aphides, viz., *Siphonophora dirhoda* Wlk., *S. rosae* Reau. and *S. rosarum* Walk.

The first migrates to wheat, grasses and polygonum, the second to the teasle, whilst the last named is found to be permanent.

Treatment thus necessarily depends on the particular kind of aphid attack. If it is only *Siphonophora rosarum* Walk., then one or two early sprayings with soft soap and quassia will suffice, but if the others occur as well and they are both very common, many subse-

quent sprayings will be necessary, for both migrate from their other food plants over some weeks.

It may be pointed out here that for roses nothing but soft soap and quassia should be used. Too frequently one finds paraffin emulsion employed, the result is always harmful to the roses, and if a good drenching is given of soft soap and quassia it is sufficient. Two sprayings consecutively are necessary because young I find may escape from the viviparous females some hours after they have been dead. As much as 10lbs. of quassia may be used to 100 gallons, but not more than 4lbs. of soap. More than this will frequently damage the tender leaves.

An Aphis (*Siphonophora circumflexa*) Attacking Salvias.

Specimens of salvia leaves attacked by an Aphis were received in June from Lee. They were badly damaged and had also Red Spider on them in small numbers.

The Aphis was examined by Mr. Rothwell and proved to be the *Siphonophora circumflexa* of Buckton. The salvias were frame grown.

The Ivy Aphis (*Aphis hederæ* Kalt.).

Specimens of ivy shoots covered by a Black Aphis (*Aphis hederæ* Kaltenbach) were received on the 12th of June from Blackheath, and others from Lynmouth in July.

It has been found twice at Wye, in 1901 and 1904, and Buckton mentions it from "Chichester and other places."

It also infests holly and there is no doubt that Kaltenbach's *Aphis ilicis* is the same species.

It probably has some other food plant from which it migrates.

The Ivy Aphis is only known in its apterous and winged viviparous forms. In the former its body is uniformly dull brown, legs pale brown or grey, with black tarsal segments. The winged female is also dull brown; legs brown or pale ochreous with black tarsi, wings with yellow insertions and black stigma and brown veins.

They mainly congregate and breed on the young shoots and cause considerable distortion. I have usually found them at Wye on ivy growing close to walls, alike in exposed and sheltered places.

ANIMALS INJURIOUS TO FOREST TREES.

Ants Attacking Seedling Trees.

Exhibited at the Royal Show at Derby were some seedling trees said to be attacked and destroyed by ants. In July Mr. Reid, forester to the Ashton Court Estate, Gloucestershire, sent me specimens of beech, ash, larch, and Scots firs damaged and killed by ants.

The appearance was just such as one sees caused by chafer larvae in nurseries, but the true cause was clearly traced. The soil in which they grew was shallow in some places and very hot, resting on carboniferous limestone. It was planted two years last December and had been previously rough pasture land.

Mr. Reid informs me that the plants seemed to commence growing in the early season all right, and from what he could judge till once the ants begin to wake up from hibernating in their hillocks. He found that they had a tendency to attack plants rather deeply planted, and in most cases worked them near the surface of the ground.

Mr. Barker, of the National Fruit and Cider Institute, Long Ashton, Bristol, also wrote me that large numbers of the young trees are being killed on the Long Ashton Estate.

Mr. Reid writing me again in August, in connection with a communication I sent him, says, "I have never seen a weevil on the place, but I was suspicious of the cockchafer grub, although I could never find any."

At the same time he sent specimens of the ants which were present in such numbers, and they proved to be *Lasius flavus*. This ant is common all over Britain, and it is possible that its attack when present amongst young plants in some numbers may not be unusual, but as far as we know the damage recorded by Mr. Reid has not so far been observed.

The Larch Sawfly (*Nematus erichsoni*).

This insect, which has been so admirably dealt with by Dr. MacDougall in The Board of Agriculture Journal, was sent by Mr. Hill, of the Agricultural College, Aspatria, in October, in the pupal stage. The cocoons sent were found in a 200 acre larch plantation, which had been badly attacked about four miles from Keswick—elevation 1,000 to 1,500 feet above sea level. This sawfly is of far wider distribution than is generally supposed, but has not before been recorded as injurious in this country. Readers are referred to the article quoted for further reference.

The Buff Tip Moth (*Pygaera bucephala* Steph.).

This beautiful moth seems to have been so abundant over the South, South-East, and South-West of Britain during the past year that it has become a pest in several localities in various ways. On the 16th of August specimens were sent from Sowton, near Exeter, that were destroying copper beech trees in that neighbourhood; in the same month they were reported as damaging limes in North-West London, from Suffolk on beech trees in gardens, and in several parts of Kent on beech and goat willow.

It has also occurred as a fruit tree pest (*Vide* p. 44).

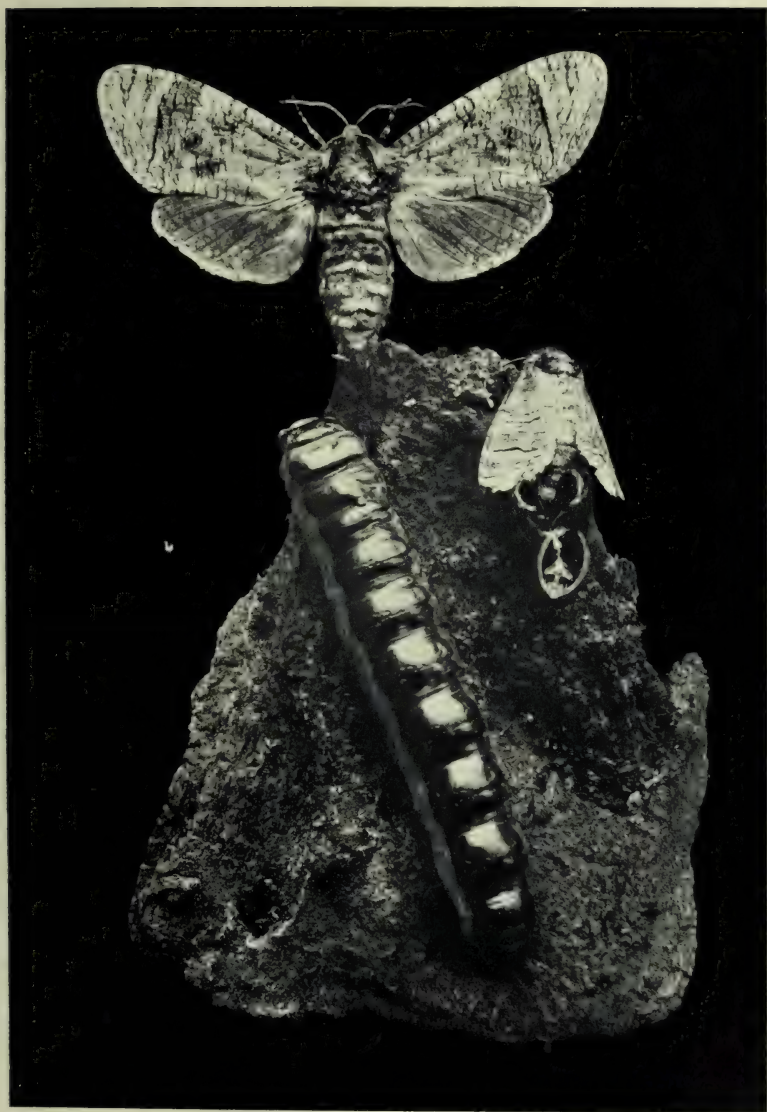
Large numbers of the larvae were kept and from these moths started hatching out in March. This is very anomalous as the pupae were kept in a cold cellar. Five hatched before March 26th.

The Goat Moth. (*Cossus ligniperda* Fab.).

The Goat Moth is annually reported as a serious enemy to trees. Yet it is strange, in spite of all we know of it and the certain means of destroying it, that little is done to check it, and the result is that a great loss of timber results. It is only when it attacks trees in private gardens and parks and public enclosures that one hears of it, yet it causes endless loss in other places.

During the past year it has been reported as doing much damage in the Alexandra Pleasure Grounds at Sydenham, under the management of the Beckenham Authority. Some of the attacked trees have been blown down, and every other tree of the same variety is in a bad way.

PLATE XXVIII.



THE GOAT MOTH (*Cossus ligniperda*) and larva.

The trees are all balsam poplars. Mr. Emptage writes me that "no other kind seems to be attacked, and that the wood and bark in all appears to be affected, and in most cases the trouble is so bad that it is beyond any remedy. A small white mite seems to follow the insects and the large quantity of 'frass' turned out has a peculiar foul smell, very like that of stale brewers' grains. I noticed that when one tree blew down in the spring, a tree quite twelve inches in diameter, that a dense white mycelium had followed the insects running under the bark and through the wood tissue."

Very much timber is being lost in and around London by this insect which could undoubtedly be saved.

So many accounts have been written that it is needless to refer to its life history here. I know of no way better to destroy it than that suggested to me many years ago by Professor Percival, namely, of placing pieces of stick cyanide of potassium in the openings and closing them up with clay. Too frequently an absurd idea is followed of running a piece of wire into the holes caused by the larvae. The holes or tunnels are tortuous and frequently three feet in length, to imagine a piece of wire will prick the large larva under such conditions merely shows that those who have advised it have never seen the inside of a tree attacked by *Cossus* larvae.

It is most important if we wish to save trees near those attacked that they should be smeared in June with a thick plaster of clay and lime or the old mixture of fresh cow dung and lime to prevent the female moths from laying their eggs. The heavy females fly very little and it need only be those trees close around the affected trees that have to be treated. If the attacked tree is treated with cyanide and those immediately around it are dressed the damage can easily be checked.

Cecid Lime Gall (*Diplosis tiliae* Schrk.).

An abundance of this gall was reported in 1906 from several parts around London, especially Sydenham, Tulse Hill and Brondesbury.

It is noticed to be most prevalent on limes that are annually pruned and which in consequence have a very soft growth.

They do not seem, however, to do much harm, but look unsightly. I am not aware that the adult has been described.

Walker * describes the galls as being found in June, not uncommonly on the young shoots, growing from stumps of lime trees by the banks of the Wye, near Chepstow. I found them there still in numbers last year. They vary much in shape, some are round, some oblong, some irregular masses; in colour they may be green, red on one side or all dull red. As many as forty bright yellow larvae may often be counted in one gall, but as a rule from ten to twenty.

Felted Beech Coccus (*Cryptococcus fagi* Baren).

The destructive Coccus still seems on the increase.

A bad case was reported in September in the Caterham Valley. With the specimen the following note was sent, "the brown bark is from a tree killed by the scale, it appears to me to be not long in doing so, as I have only noticed it here about eighteen months at the outside." It is very harmful in the Chiltern Hills.

A fine beech, badly infested, was seen at East Peckham, standing quite isolated from any other beeches.

Numerous cases have been reported from Surrey.

No further notes can be added in regard to treatment to those given by Mr. King in the last report. A strong petroleum emulsion is the only means of saving the tree, and this must be applied three or four times to have the desired effect, but owing to the almost assured fatal effects of this coccid this is well worth doing in parks and gardens.

Large trees may be easily sprayed, if the machine is placed on a stage on a cart and long rods used for the nozzles.

Pine Chermes (*Chermes corticalis*, Kaltenbach).

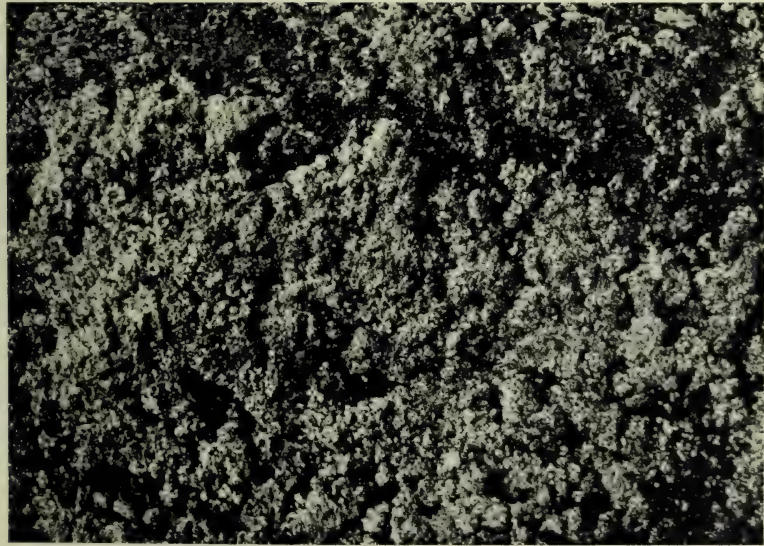
A bad attack of this Chermes on Silver Fir was reported in August in 1906, from Wragby by Mr. Orwin.

No further reference is made here to this white woolly conifer pest, as a special paper is being prepared on this and other allied species found on conifers in this country.

The Oak Leaf Phylloxera (*Phylloxera quercus* Boyer de Fonsc.).

This Oak Aphis has recently been on the increase in Britain. It was not recorded by Buckton, but he referred to it and at the same

* Ins. Brit. Dipt. III. p. 130, 1851.



PIECE OF BEECH COVERED WITH *Cryptococcus*
fagi Bar.



OAK LEAVES (slightly reduced) SHOWING SPOTTING
DUE TO *Phyllostera quercus*.

time gives an excellent plate (Pl. cxxiii., figs. 1-10). The two British Oak Phylloxera are easily separated, the one recorded here makes very marked orange-yellow, circular spots on the upper sides of the leaves as seen in the photograph reproduced here.

The other known as *Phylloxera punctata* Licht. recorded by Buckton does not apparently do so. The latter species is very pale in colour, whilst *P. quercus* is orange-yellow. The winter is passed in the egg stage and it hatches in spring, usually it is laid in crevices of the bark or the axils of the twigs. The pseudo eggs are deposited by the female on the under side of the leaves in groups, but not in any definite order.

The young are slender and some show reddish tints ; wherever they collect a round yellow spot appears on the leaf above, sometimes showing a central red spot. So numerous have these been on some trees seen during the past year that the leaves were marked all over and consequently dead.

They were reported in numbers from near Bearstead, and were very abundant near Ledbury and Ross.

Buckton quotes that "in about a fortnight they (the larvae) become pupae and the first winged females appear late in May or in early June. At this stage all the winged insects are stated to migrate to the hairy oak *Quercus pubescens*, and there they drop their pseud-ova. The resulting apterous females apparently do not give rise to winged forms until August."

As far as I had opportunities of observing, this species remains on the same oak all the year.

It seems mainly to attack small trees, suckers and nursery stock. In the latter it may do no small amount of damage. At Bearstead I saw one tree quite stunted by its repeated attacks from year to year.

ANIMALS INJURIOUS TO MAN'S STORES, ETC.

Mites (*Tyroglyphus siro* Linn.) in Chicken Food.

A badly spoiled sample of chicken food attacked by mites was sent for examination and report by the Poultry Club.

It was particularly desired to be known whether it was harmful to chickens, especially small chicks, etc. An examination showed that the food was attacked by minute acari, known as *Tyroglyphus siro*. This mite was swarming in the sample of food sent and had almost reduced it to dust.

Tyroglyphus siro is found in cheese and milk, and any kind of farinaceous substance. It mainly seems to feed in colonies, and these increase rapidly when in warmth. They have not been known to attack poultry, and although the sample of food stuff sent was really valueless, its use would not lead to any parasitic infestation in the birds.

The mites breed in the substance they attack, and all manner of stages of life could be found in the fowl food sent.

A Bee (*Colletes succincta*) Making its Nest in Sheets.

A strange place for bees to make their nests was reported from Dene Park, Tonbridge.

Mrs. Hollams wrote, saying that the "Strange nest of grubs was found lying between sheets on the top of a cupboard in a bathroom for several weeks, and they were found stuck together by the nest of grubs."

These proved to be the larvae of a bee known as *Colletes succincta*.

ANIMALS CAUSING ANNOYANCE TO MAN.

Rats in Connection with Plague.

Information was sought from the Plague Department, Calcutta, concerning the different species of rats.

Plague breaks out in Calcutta every spring, and only lately have the authorities got any assistance in exterminating the rats from natives. Information was sent concerning the apparent mixing of breeds to such an extent that there was difficulty in distinguishing the two common species.

The Black Rat (*Mus rattus*) is the common rat of Bombay, but is said not to be the common rat of Calcutta.

As only two species of domestic rats were known, Dr. Oldfield Thomas was consulted. He agreed that only two occur, *Mus rattus* and *Mus norvegicus*, and that he does not think that they are likely to interbreed. This mistake originates by taking grey *M. rattus* to be the other species. The colour differences are absolutely valueless. The only true differences are (1) the short ears, (2) tail, and (3) larger size of *norvegicus*, the converse in *rattus*, the tail in the latter being relatively much longer.

Dr. Oldfield Thomas further adds that no other species are likely to occur in houses, though the two forms of *M. rattus* might do so, namely the *M. rattus rufescens*, and the introduced *M. rattus typicus*.

These two forms are distinguished by colour, the former being reddish above, the latter by being blackish. The colour below is quite immaterial.

Mus rattus is nearly extinct in Britain, but a specimen was seen by me last year in Devon.

Biting Midges (*Ceratopogon* sp.) in Scotland.

Specimens of small midges were received in the middle of June from Ayrshire, Perthshire, Sutherlandshire, which caused much annoyance to people in parts of those counties. They proved to be *Ceratopogon pulicaris*, Linn. which is a well-known annoying human pest in Britain and on the Continent. These small Chironomid Flies mainly attack the hands, neck and behind the ears, and cause somewhat painful wounds, although small. They generally attack in numbers, and so cause much inconvenience.

The larvae live beneath the bark of decaying trees, and those of some species in manure, others in water. They are cylindrical white grubs slightly enlarged in front, a small retractile head and deeply constricted segments with appendages on the prothorax and anal segment.

They pupate under the bark. The pupae have two short lateral appendages.

Those larvae belonging to species with hairy wings live under the bark of trees; those belonging to species with nude wings are aquatic.

The pupae of the first-named remain partly sticking to the larval skin. The respiratory syphons are very small or absent and the abdomen has various spines and setae.

The aquatic *Ceratopogon* larvae swim with a sinuous movement, and are white in colour, and slender, and these have delicate white blood gills projecting from the rectum. The pupa also occurs in the water and floats at the surface, being quite inactive, or it may be attached to water plants. The respiratory trumpets are slender and cylindrical.

Besides living on man's blood, they also attack small insects. Walker (*Insecta Britannica* Diptera III., p. 207), says those species whose femora are armed with spines pierce other small insects with their sharp proboscis.

The *Ceratopogon pulicaris* of Linnaeus, is the commonest and most annoying British species. The wings are pale with brown spots, the three on the costa being larger and darker than the rest. The pallid legs have the tarsal segments with darker tips, and the grey thorax has a dark stripe on each side in front of the

wings; the dark abdomen has pale bands. Its length is only 2.5 mm. and the wing expanse 4 mm.

They seem to dance in clouds, and are particularly plentiful in marshes and along the borders of woods.

No less than sixty-one species are known in Britain, and this list could be much extended by any person working at the group.

Like many other aquatic Diptera except some Culicidae, the water living *Ceratopogons* pass the winter in the larval stage.

The few records there are show that the eggs of the water species are laid in star-shaped clusters.

A common aquatic species is *Ceratopogon bicolor*, whose white larvae are to be found moving amongst confervae, etc.; they are almost nude, but there is a curious tuft of bristles at the apex.

Another curious form sent during the past year was found in the sap of some trees that were bleeding. This was probably *Ceratopogon dufouri*, which Laboulbène describes from the sap of wounded elms (Ann. Soc. Ent. de France. Fourth Section, ix., 1869).

House Fly Annoyance.

The House Fly (*Musca domestica*) has been very abundant during the past year. It has been reported from near Worcester as having been "a regular plague all through the latter part of the summer." One correspondent writes: "They have been appearing in large quantities since August, every room in the house, more especially dining-rooms and kitchens, being invaded."

One of the most serious attacks was reported by the Great-Eastern Railway at Colchester station, the restaurant and refreshment rooms being invaded by hordes of the insects during the summer, and on into the autumn. From numerous specimens sent by the Company, the species was found to be only the common house fly.

The vicinity was inspected in October, and the breeding grounds found.

This muscid mainly breeds in horse manure. Three such breeding places existed; the worst probably was not in any way

connected with the railway. Steps were at once taken to remove them.

Local sanitary authorities should be instructed to see that any refuse heaps under their jurisdiction are properly treated. It is not at all infrequent to find street refuse in which horse manure plays no small part, shot down in heaps and left exposed. These rubbish heaps, as well as actual stable manure, form centres for house fly reproduction.

When one remembers not only the annoyance caused to animals and man by the House Fly, but that from Dr. Sandiland's

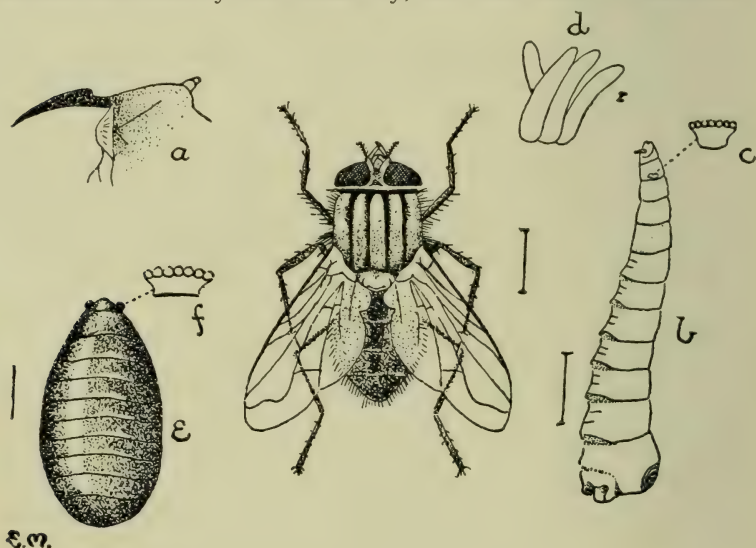


Fig. 20.

THE HOUSE FLY (*Musca domestica*).

a. head of larva ; b. larva ; d. ova ; e. puparium ; c. and f. spiracles.

observations it plays such an important part in that decimating disease, "infantile diarrhoea," it is surely necessary that steps be taken to see that such filthy practices are stopped.

One interesting habit has come to light, during recent investigations, namely, that *Musca domestica* will breed largely in rotting cow dung mixed with vegetable matter. This seems to be a favourite breeding ground of many muscid flies besides.

The part the "house fly" plays in the spread of Enteric Fever has also to be considered, and lends more importance to the necessary checking of its undue increase. The destruction of horse manure near man's habitation is the main thing to do. One has only to look at results in London, to remember the great decrease of this pest during the past twenty years, to see what could be done elsewhere.

The Harvest Bug (*Leptus autumnalis* Shaw.).

Numerous complaints reached me during the year of the annoyance caused by Harvest Bugs.

Amongst other localities where it was very annoying were Presteigne, Radnorshire; Chepstow, Monmouthshire; various places in Surrey, and on some dry spots in Hampshire. This small acarus is known as *Leptus autumnalis*.

It is usually noticed to be worst in barley stubble and amongst long dry grasses. They live, however, almost everywhere, although chalky soils seem most favourable to them.

Gilbert White, in his "Natural History of Selborne," mentions them as swarming to such an extent in the chalk districts of Hampshire that in the rabbit warrens on the Downs, they discoloured the nets of the warreners, giving them a reddish-hue. Downs near the sea are always infested in warm dry weather.

They not only attack man, but also cows, horses, dogs, cats, mice and poultry.

It is recorded that cavalry horses, after autumn manœuvres, suffer from an erythematous affection about the knees and hocks, due to these "harvest bugs."

Man usually obtains them by contact with grasses and other herbage, but also may catch them by handling wild and domestic animals. Most of the records of people infested by red spider when picking nuts and fruit have really been attacked by this parasite.

They can undoubtedly persist solely in vegetable food.

Those that attack man burrow under the skin and into the sweat glands or roots of the hair and also live on the skin, where they set up irritation. In a short time large red swollen patches appear at and around their point of entry.

They do not persist very long. No reproduction takes place on man, the Harvest Bug being a larva, not a mature acarus.

What this Harvest Mite in the larval stage is, we do not know for certain.

Megnin in 1876, asserted that it was the larval form of *Trombitium holosericeum*, a large bright red mite, that occurs in plenty in gardens and fields, in spring and early summer. In June and July he found that this acarus deposited eggs from which reddish larvae of small size (0.23 mm. in length) hatched out. Moniez disputed this and showed that the characters of the larvae did not exactly agree with those of the parasite. Later, Hanstein revived an old opinion that the Harvest Bug is only the larva of the Red Spider, *Tetranychus telarius*. This latter theory may be discarded at once, for the life-history of the *Tetranych*i, especially of *Tetranychus telarius* is well known. There is not the faintest resemblance between a young red spider and *Leptus*.

Personally I have failed to separate the young *Trombidium holosericeum* from the larvae taken in man, and I feel convinced that Megnin was quite correct.

There are several Trombidia, and I think that they all in their larval stages affect animals and man.

Every year the large velvety Trombidia are sent from gardens and fruit plantations. I have noticed them in spring most commonly amongst peas, beans, and on fruit trees. In length *T. holosericeum* is about one-twelfth of an inch and is of a bright velvety red colour. They seem to do no damage to plants, but in June and July they lay many eggs, from which orange-red larvae hatch; the larvae soon become transparent, and these crawl up grasses, roots, garden plants, etc., and thus gain the surface of any passing man, or mammal, or bird.

Frequent inquiries as to preventing this pest from attacking man come every year. So far I have only known oil of citronelle bathed over the limbs before walking do any good, and some relief seems to have been obtained by carbolic washings.

The adult *Trombidia* hibernate under bark of trees and at the foot of hedgerows, and these, perhaps, may be lessened by destroying their winter quarters where repeated attacks take place in small local areas.

That they may come from rough herbage growing near any particular spot is well known, and by burning this in July when possible, the harvest mites may often be destroyed in numbers.

Various allied species are found all over the world, for information concerning which the reader is referred to the English translation of Braun's "Animal Parasites of Man."

Destruction of Ants in the Ground.

In July the following communication was received :—

"Mr. Idiens desires me to write and ask you if you will kindly send some remedy to destroy ants in the ground, which is sand and loam infested with a large black ant, which bites when any opportunity affords.

"The local remedy is to burn with paraffin, but with such dry weather the grass is dangerous, on account of fire."

Frequent trials have been made with bisulphide of carbon as a means of destroying ants, and in all cases it has proved beneficial when used once, but to ensure the complete destruction of the colony two injections are always desirable at about three weeks' interval, and sometimes a third is necessary. This depends on the state of the colony. For the large nest of *Formica rufa* about four ounces are required, but for the smaller ones of other species two or three ounces generally suffice.

All that is necessary is to make a hole about six inches deep in the centre of the nest, pour the liquid in and close it up rapidly with earth. It is best to do this when the soil is dry.

GENERAL NOTES.

Aphodius Beetles in Imported Dung.

These beetles were forwarded in May with a note that they are "being brought over from America in great numbers, and are being distributed broadcast in manure amongst fruit growers. Do you know anything of the insect, whether it is at all likely to do damage in this country? I can furnish you with all particulars."

Information was obtained, which showed that these beetles were in very large numbers in the foreign manure coming from the cattle ships arriving from America at Avonmouth, this same manure passing on to the strawberry growers in the Cheddar district. Their numbers are very great.

The genus *Aphodius* is not injurious, but it shows how easily insects can be and are imported to this country. The species is *Aphodius junietorum*, which is common to Europe and America. It feeds in both active stages in dung and decaying animal and vegetable matter. Information was sent that it was not injurious, and does not so far affect strawberries.

But when we consider the carrion feeding so-called Mangold Beetle's (*Silpha atrata* and others), causing such damage to plants as they do, we must necessarily look upon this importation with some uneasiness.

Imported Bamboo Borer.

A piece of tunnelled bamboo was sent in November by Mr. Emptage. The culprit was a large Bostrichid Beetle, which is well known as destructive to bamboo and which not only attacks the living, but dead canes. The insect was alive, and hence some misgiving concerning the possibility of its doing damage in this country.

Possibly if numbers of these beetles got into furniture made of bamboo they might exist, as domestic insects, but it is very unlikely that they would do so.

EXTRA BRITISH INQUIRIES.

Hop Flea in British Columbia.

A very serious attack of Flea Beetle has during the last two years taken place on Sir Arthur Stepney's ranch in British Columbia.

In connection with this, Mr. John Roberts, Sir Arthur's agent, visited Wye to obtain information concerning the pest and its treatment. He had been informed that the insects were the Hop Flea found in Britain (*Psylliodes attenuatus*).

This was considered doubtful, as that species does not occur in America.

After his visit Mr. Roberts sent the beetles, and they proved to be the well-known American Flea Beetle (*Psylliodes punctulatus* Walsh), as was to be expected.

The matter is an important one as it might have given rise to the idea that the British Flea Beetle had been imported with hop sets from this country and so have hindered their sale.

Just as in this country, two methods of coping with the pest offer themselves to those in America, and these two were advised: namely (1) the employment of ducks and fowls penned in the hop yards; (2) spraying the young shoots with arsenate of lead.

The objection to the latter treatment because of the scare of "arsenic in beer" is puerile.

Later Mr. Roberts wrote that he had found that by turning 500 ducks into a yard in winter and spring, highly satisfactory results had been obtained.

Late in August, Mr. Roberts heard from the overseer that the Flea Beetles had disappeared, but not until forty to forty-five acres of hops were completely spoiled. He found the beetles had gone into the earth.

This so-called Punctured Flea Beetle is one of the commonest species injurious to hops in America; two others also occur at places in numbers, namely, the Red-headed Flea (*Systema frontalis*), and the Striped Flea Beetle (*Phyllotreta vittata*).

Corn Weevils (*Calandra granaria* & *C. oryzae*).

Samples of badly damaged maize were received from Liverpool from Mr. Holt that had been shipped from West Africa. They were found to be infested with the two common corn Calandrae or Weevils.

These beetles seem to be doing more widespread damage every year. They have been particularly harmful to maize both on the West and East Coasts of Africa, and similar reports have reached me from the Argentine.

Bisulphide of carbon treatment is quite successful.

The Olive Fruit Fly (*Dacus oleae*).

An inquiry was received from Mr. George Arnold, of East Peckham, Tonbridge, wanting information concerning the Olive Fruit-fly, which is stated to have damaged the olive crop in Southern Italy to the sum of £6,000,000. This statement sent was from a newspaper cutting, and it continues thus: "The Italians are alone to blame for existing conditions. For years they have snared and trapped every kind of bird, both large and small, with the result that Southern Italy is almost depopulated of the feathered tribe. Thus the Oil Fly increases and flourishes unchecked. *The work of importing birds has already begun*, but it will be some years before they materially decrease the hordes of insects."

The italics are mine. In consequence of this communication, I wrote at once to Dr. Antonio Berlese, who is the chief authority in Italy, and who is in charge of any such matters. The following is from his reply:—

"Per combatterla non si pensa affatto di introdurre qui degli uccelli, ma invece si adoperano delle soluzioni arsenicali come Ella pottà vedere da due mie note che mi onoro spedirle separatamente."

The complete contradiction of the first statement by the chief authority in the country shows how careful we must be in taking note of "newspaper entomology."

Cleonis punctiventris **Destructive to Beetroots on the Continent.**

Information was sought by a correspondent concerning this beetle, which is known as a beet and sugar-beet pest on the Continent, and which is said to have been very harmful in Russia during the past year or so.

Taschenberg refers to it as follows:—

“In the Ukraine and in Hungary, and probably also in other countries, the beetle often occurs in large numbers, and for a long time has been regarded as destructive to turnips. Possibly its larva does more harm underground than the beetle above ground. Both undoubtedly feed on other plants also, and would destroy other products. For that reason the beetles should be carefully collected and destroyed the moment they appear, which they do early in the year; as the insects are very hard, chickens will not feed on them.”

Termites or White Ants Attacking Tea Plants.

Some White Ants were forwarded by Mr. Kirby in October, which had been doing considerable injury in tea plantations in Assam.

The species Mr. Kirby had identified as *Termes obesus* Ramb.

The attack of White Ants on tea plants is not of common occurrence, nor do they but rarely attack any growing plant. Reference has been made before in these Reports to such work, however, especially in connection with their attack in Para rubber trees in the Federated Malay States.

The African Dura Aphis (*Aphis sorghi* Theobald).

This Aphis has been recently sent me from Northern Nigeria, and also by Mr. Lounsbury from South Africa, who wrote that “It has been troublesome in Natal and part of the Cape Native Territories for about three years, chiefly to Kaffir corn, a kind of sorghum.”

The specimens sent by Mr. Lounsbury for identification proved to be exactly the same as those I described from the Sudan.

It will probably be found to be widely spread over the African Continent. Probably there are several other species also which attack the same corn crops.

Protection of Timber from White Ants.

An inquiry was received from the Imperial Institute as to whether creosoted timber is impervious to white ants.

The extensive use of creosoted railway sleepers in the tropics was thought to indicate that such wood will stand insect attacks fairly well.

Bumble Bees and Clover Fertilisation.

This important subject has been worked out by Mr. C. Mason, whose report is added here. The action of Bumble Bees (*Bombi*), on the fertilisation of clover, is looked upon in New Zealand as of great importance. Mr. Kirk, the Government Biologist, writing again in August, says: "We are anxiously looking forward to the Report, as the matter is of the greatest importance to us here."

I can only say I quite endorse Mr. Mason's Report, and consider that in this country the *Bombi* have little to do with the fertilisation of clovers, lucerne and sainfoins.

REPORT ON BUMBLE BEES (*Bombi*) AND CLOVER *re* COMMUNICATION FROM THE DEPARTMENT OF AGRICULTURE OF NEW ZEALAND.

BY C. MASON.

The following notes were made with the object of supplying material from which conclusions might be drawn as to which of the common *Bombi* was the most beneficial agent in flower fertilisation in the case of clovers, and in particular of red clover (*Trifolium pratense*).

The communication from Mr. Kirk was:—"Some years ago it was difficult to grow red clover in this country, but the introduction of the Bumble Bee quite altered matters, and we have now very fair success. It is, however, felt we may not have the best bee for the purpose. We have here *B. terrestris* and *B. sub-*

terraneus. Would you favour us with your opinion as to whether a species with a longer tongue would be better for the fertilisation of red clover, etc."

From this communication we may conclude that in New Zealand the honey-bee (*Apis mellifica*) is of little value for the fertilisation of red clover, etc., as until the importation of *Bombi*, these crops could not be grown profitably for seed in that country.

Most authorities consider the length of the tongue to be one of the most important points in deciding the most beneficial species, as regards flower fertilisation, for the following reasons:—

(1) A bee will not visit a flower if it cannot reach the honey, or

(2) as in the case of *Bombus terrestris*, it will pierce through the corolla, or whatever part of the flower prevents it getting at the honey. In this case fertilisation does not take place with the bee as an agent, and in addition, other bees and insects visiting that flower, use the hole the former bee made, and so do not use their beneficial qualities, if they have any.

(3) A bee with a long tongue will fertilise flowers a short-tongued bee cannot reach, provided the former's tongue is not abnormally long, and may be able also to fertilise the flowers a short-tongued bee can reach. In this latter case, however, the short-tongued bee is best.

In selecting the most beneficial bees, the following must be carefully considered. A bee fertilises most of the papilionaceous plants by means of its back and head, on the hairs of which the pollen collects. It is therefore obvious that a bee with a very long tongue would not perform fertilisation, as the bee could get at the honey (if only collecting honey), by remaining outside the flower, and merely inserting its tongue. This can be easily seen in the case of moths and butterflies.

During the summer at Wye (1906), only four species of Bumble Bees occurred in any number. A few specimens of several other species occurred now and then, but not in sufficient numbers for examination. A great number of the four commoner species were taken, the tongue and mentum of each bee being measured under the microscope immediately after death. Microscopic slides of the tongues of each species and sex were made.

The bees examined were *B. lapidarius*, *B. terrestris*, *B. hortorum*, *B. sylvarum*. The length of the tongue was taken in millimetres.

		♂	♀	♀
<i>B. lapidarius</i>		14	9.5-14	9.5-14
<i>B. terrestris</i>			9	7-9
<i>B. hortorum</i>			12	7-8.5
<i>B. sylvarum</i>			14	6-8
<i>B. barbutellus</i>		11.5	11.5	

In accordance with the considerations mentioned above, we may conclude from these measurements that of our common *Bombi*, *B. lapidarius* is of the most importance for fertilisation; *B. terrestris* and *B. hortorum* are about the same, though *B. terrestris* in a year when clover flowered early, would prove of more value than *B. hortorum*, as it appears earlier by several days in large numbers (♀). *B. sylvarum* would apparently be fourth on the list.

Though *Bombi* may be necessary for a thorough fertilisation of clovers in New Zealand, from certain observations made during the summer, it would appear that *Bombi* do not affect some cultivated species of leguminous crops to a great extent. Frequent visits were made to a sainfoin field in full flower (five visits in ten days), in perfect days for the bees to work. During these visits only three *Bombi* were observed—two *B. terrestris*, one ♀ and one ♂, and one ♂ *sylvarum*. *Apis mellifica* was practically the only insect at work, and was on the flowers in great numbers.

From this we may conclude that for the fertilisation of all leguminous crops, *Bombi* may not be necessary, or that they will not visit all species of leguminosae, only selecting certain species for visitation.

The work seems to be mainly performed by the Hive Bee and small diptera.

REPORTS FROM THE ANALYTICAL LABORATORIES.

GENERAL ANALYSES

BY

H. E. ANNETT, B.Sc. (Lond).

FRANCIS V. DARBISHIRE, B.A. (Oxon.), Ph.D. (Leipsic.) ; and

EDWARD J. RUSSELL, D.Sc. (Lond.)

SOIL ANALYSES

BY

ARTHUR AMOS, B.A. (Cantab.) ; and

EDWARD J. RUSSELL, D.Sc. (Lond.)

FIFTH REPORT

FROM THE

ANALYTICAL LABORATORY.

BY

H. E. ANNETT, B.Sc. (Lond)., FRANCIS V. DARBISHIRE, B.A. (Oxon.),
Ph.D. (Leipsic) and EDWARD J. RUSSELL, D.Sc. (Lond.)

Last year more than 250 samples of various substances of agricultural importance were sent in for analysis, and it is proposed in this report to give a brief account of some, and a more detailed account of others, of general interest.

MANURES.

FISH GUANO.

The uniformity in composition of fish guano has been commented upon in the previous reports; sample 184 sent in this year showed little deviation from the average. Sample 215 was very wet and had been damaged in the ship, but there was no evidence of any serious damage. We have received excellent reports this year of the beneficial effects of fish guano on lawns which tend to dry out in late summer.

Ref. No.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
215	6.15	7.47	5.26	11.49
184	8.16	9.9	6.6	14.38

The samples received here during the last four years fall into two groups, those yielding 10 per cent. of ammonia and 15 per cent. of phosphates, described as high-class Grimsby make, and those yielding 10 per cent. of ammonia and 20 per cent. of phosphates. These are light in colour and very bulky.

There is also a cheaper grade, yielding 9 per cent. of ammonia, and 13 per cent. of phosphates.

MEAT GUANO.

This substance is prepared from waste meat, greaves, and chilled imported meat which has been condemned owing to the breakdown of the refrigerating machinery on board ship. The first process consists in the removal of the fat; for this purpose the meat is placed in jacketed vessels heated by high pressure steam and the molten fat, rising to the surface, is ladled out and run through a sieve into tubs. This fat, or tallow, is a valuable commercial product, and is used by soap makers, candle makers, and others. The residue is subjected to pressure to remove as much fat as possible, and the resulting cake broken up, dried, and separated by shaking from foreign material like iron, glass, etc.; it is then finely ground and constitutes meat guano. A certain amount of fibrous material only yields to grinding after treatment with sulphuric acid. Some bone is invariably present.

Other grades, poorer in nitrogen but richer in phosphate, are obtained by adding weighed amounts of bone before the last grinding; the whole is made to a definite composition.

	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
Dry, fat-free flesh *	16·67	20·32		
Nitrogenous meat guano	7·8 to 8·7	9·5 to 10·5	4·6 to 6·9	10 to 15
Phosphatic meat guano	4·2 to 5	5 to 6	16·1 to 18·4	35 to 40
Pure bone	5·0	6·07	22·0	48·04

* Köhler, *Zeit. Physiol. Chem.*, 31, 479.

Some meat guano is also imported from the meat extract producers of South America.

Clean samples of meat guano are sometimes used as poultry food, but it is always desirable to ascertain beforehand whether this can be done with safety.

BONE MANURES.

Three samples of bone meal and one sample of vitriolised bones were sent in :—

Ref. No.	Description.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
26	Bone meal	4·5	5·4	21·48	46·92
24	„	4·04	4·9	22·6	49·3
40	„	3·6	4·4	22·6	49·3
137	Vitriolised bones	1·42	1·72	12·79	27·93
				soluble 8·96	19·55

POTASH MANURES.

These call for no remark.

Ref. No.	Description.	Potash.	Equivalent to Sulphate of Potash.
732	Kainit	11·27	20·69
	„	8·27	15·3
146 and 168	„	12·26	22·72
193	Sulphate of potash	49·05	90·78

GUANOS.

Equalised.—No. 725. As this is a mixture of guano with mineral manures, its composition can be regulated at will.

Phosphatic.—No. 726. A sample which came in this year was lower in phosphates than usual, but we understand that guanos with high percentages of phosphates have been scarce this year.

Ref. No.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Potash.
725	6·7	8·13	12·57	27·38	2·8
Guarantee	—	8 to 9	—	25 to 30	1½ to 2
726	3·4	4·13	22·9	50·0	—

NITRATE OF SODA.

The samples were all good and of 96.5 to 96.8 per cent purity.

SULPHATE OF AMMONIA.

Only one sample was sent in: it was in excellent condition, and contained 24.57 per cent. ammonia, equivalent to 95.4 per cent. sulphate.

RAPE DUST.

For many years this substance has been regarded with favour by farmers, and as long ago as 1848 we find a very appreciative account given in the *Journal of the Royal Agricultural Society* (Vol. 4) by Mr. Hannam, a well known writer and tenant-farmer in Yorkshire. Owing to the limited supply, and to the fact that some is used for feeding purposes, the price is always high, and the unit price of ammonia higher than that in fish or meat meals.

Ref. No.	Nitrogen.	Equivalent to Ammonia.
184	4·71	5·72
	4·9	5·95

We have received the following quotations recently:—

Rape dust from East Indian seed - 20/0 per unit of ammonia.
 „ „ oil extracted (“Homco”) - 16/6 „ „ „
 Castor meal „ „ - 14/2 „ „ „

About 1 per cent. of potash and 4 per cent. of phosphates are present and are allowed for in the above estimate.

POND MUDDS.

Two interesting samples of mud from the bottom of ponds came from Smarden. A was from a pond which had not been "mudded" since 1836, and as neither ditches nor drains run in, the water supply is only kept up by percolation through the soil, which is described as a sandy clay. For many years the pond has throughout the summer been a mass of weeds, mainly silk weed and *nymphaea alba*.

B is from a pond into which a little ditch and several drains run. It was expected that the mud would be very rich, and it was being applied as a dressing for hops, but analysis showed that the mud was little, if any, richer than the soil of the hop garden, and that as a fertiliser it was useless. The fermentation processes going on at the bottom of a pond are very complete, organic matter is broken up into carbonic acid, marsh gas, and hydrogen, and free nitrogen is probably liberated also. Resistant forms of organic matter would survive, but these have little value as manure.

Ref. No.		Water.	Organic Matter.	Nitrogen.
175	A	23.3	7.8	.183
	B	52.2	7.3	.175

SEPTIC TANK DEPOSIT.

811.—This was found to contain .48 per cent of nitrogen, equivalent to .6 of ammonia: it was a very friable, dry powder, very promising as an organic basic for a mixed manure. What quantity is available we do not know, but if the price was low—say 6s. a ton—this substance would be very useful.

SEAWEEDS.

Three samples of "seaweed" came in from an old student at Jersey, where large quantities are used as manure: one was not seaweed, but only a grass; the other two were *Fucus* and *Laminaria* respectively. The grass is collected from bays with sandy bottoms, fairly free from rocks.

The method of using seaweed in Jersey has been described by Mr. J. D. Bauche in the *Agricola Club Journal*, May, 1906. Large quantities are used, over eighty-five tons to the acre if applied early, but less if late. The grass is not put straight on the land, but made into a compost.

Ref. No. 207.

Composition of the wet samples, as they reached us.

	Fucus.	Laminaria.	Grass.
Water - - - -	30·53	52·84	22·6
Organic matter - - -	51·31	30·00	59·07
Nitrogen - - - -	1·56	·70	·525
Equivalent to ammonia - - -	1·89	·85	·72
Mineral matter - - -	18·16	17·18	18·33
Containing potash (K_2O .) - - -	4·51	3·67	·56
Phosphoric acid (P_2O_5) - - -	·50	·43	·62
Equivalent to tricalcic phosphate -	1·10	·93	1·35
Sand - - - -	·86	·54	2·80
Composition when dried at 100° :—			
Organic matter - - -	73·86	63·59	76·32
Nitrogen - - - -	2·25	1·48	·68
Mineral matter - - -	26·14	36·41	23·68
Percentage composition of Ash :—			
Potash - - - -	22·5	15·81	2·90
Phosphoric acid - - -	2·51	1·79	2·95
Equivalent to tricalcic phosphate -	5·49	3·90	6·45

The fucus is extremely good, a manure of similar composition would cost £2 per ton : the laminaria comes next, being worth perhaps 10s. per ton less, and the grass is the poorest, as the Jersey farmer has already discovered, having only about one quarter the value of the fucus.

This analysis was made by Mr. C. T. Gimingham.

GREAVES.

This substance is substantially the same as meat guano, the difference being that greaves is a waste product sold by soap boilers and others, and therefore liable to variations in composition, while meat guano is a definite manufactured substance, the composition of which can be regulated.

Ref. No.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
148	6·69	8·12	5·89	12·85
37	5·6	6·8	5·12	10·96
212	5·16	6·26	4·66	10·18

No. 148 is sent out by a large firm of soap boilers. Nos. 37 and 212 are probably derived from the same source, they were offered at £4 7s. 6d. per ton. Assuming the phosphate to be worth 1s. 4d. per unit, the ammonia works out to 10s. 6d. a unit, a very reasonable figure this year.

WASTE PRODUCTS.

We have received a black powder, said to be the refuse from a distillery ; its composition was very satisfactory, and its mechanical condition excellent. Most of the phosphate was soluble in water.

The damaged cotton cake was, in the first instance, offered at £3 10s. per ton, but owing to the bulk becoming heated and mouldy in the barge, the price was reduced to £2 12s. 6d. Compared with greaves 148, which is obtainable in large quantities, this price is too high, and 40s. was probably as much as the sample was worth.

	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Potash.
Distillery waste, 4	5·15	6·25	6·24 soluble 5·21	13·55 11·47	—
Damaged cake 111	3·62	4·39	1·74	3·80	1·35

A “concentrated blood, fish, and meat manure” was sent in, but its composition in no sense corresponded with its title, for it was one of the poorest manures we have seen this year.

Ref. No.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
149	2·35	2·85	·49	1·10

SHODDY.

This year's samples show the usual range of prices; the fluctuations are remarkable, and further investigation is desirable to see what are the important factors in fixing the manurial value of shoddy.

Ref. No.	Description.	Nitrogen.	Equivalent to Ammonia.	Water.	Unit Price of Ammonia.
57	Wool combings	4·87	5·92		7s. 6d.
66	Shoddy	4·16	5·05	10·16	
72	„	5·06	6·14	9·75	
84	Wool waste	4·67	5·67	35·3	} 8s.
118		4·61	5·67	33·0	
134		5·52	6·70	9·76	8s. 2d.
	Wool manure	6·6	8		6s.
	Blanket dust	4·1—5	5—6		10s.

84 was guaranteed free from oil, but in reality 3.34 per cent. was present ; it is identical in composition with 118, and both represent a well known make.

MIXED MANURES.

Neither of the two samples are excessive in price, but both suffer from the fundamental drawback that they probably supply something the soil does not want and withhold something that is required.

Ref. No.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Potash.	Equivalent to Sulphate of Potash.
138	7.22	8.76	12.49	27.24	4.50	8.33
Guarantee		6 to 8		35		3 to 5
28	4.66	5.65	19.90	43.47	0.95	1.68
Guarantee		5 to 6		42 to 44		1½ to 3

No. 138 was offered at £7 17s. 6d., and No. 28 at £7 7s. 6d.

SEWAGE SLUDGES.

Three samples have been sent in this year, and in at least two cases the price was far too high, out of all proportion, in fact, to the manurial value. That sales should be effected at these high prices shows how deeply ingrained is the prejudice in favour of substances which have passed through the body, no matter what the subsequent history may have been. None of the sludges so far examined in this laboratory showed any indication of containing the most valuable of all the nitrogenous matters, those found in the urine ; and until satisfactory evidence is offered we cannot regard sludges as useful manures at the prices now asked for them. If they were much cheaper the case would be different ; where a wet sludge can be had for the cartage or for little more, it will often yield good results on a sandy soil, partly because of its lime content and partly because of its organic matter. But the dried sludges we have seen are usually two or three times the price they ought to be. No. 160 is, however, somewhat of an exception ;

it is offered at 7s. 6d. per ton delivered, and we consider this quite sufficient, especially as peat moss dung can be obtained at the same place for 4s. or 4s. 6d.

Ref. No.	Water.	Nitrogen.	Equivalent to Ammonia.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Calcium Carbonate.
160	46.32	.58	.71	1.10	2.40	35.47
185		1.27	1.55	6.46	14.10	
162		1.8	2.3	2.15	4.69	

No. 185 was offered at £4, No. 162 at £5 10s., a comparison with No. 160, and with other manures shows how excessive were these prices:—

Manure.	Ammonia.	Phosphates.	Price per ton.
Rape cake	6	4	£5 7s. 3d.
Meat meal	7½	33	£6 10s. 6d.
Bone Meal	5	45	£5 3s. 6d.
Sludge 162	2½	4½	£5 10s.
Sludge 185	1½	14	£4

The comparison may be made in another way. The present price of phosphate is 1s. 4d. per unit: deducting this we get:—

Price per unit of ammonia in meat meal	-	-	-	11s. 6d.
„ „ „ rape meal	-	-	-	17s.
„ „ „ very high class Peruvian guano	-	-	-	22s.
„ „ „ sludge 162	-	-	-	40s.
„ „ „ „ 185	-	-	-	41s.

No one can seriously suppose the nitrogen in either of these sludges to be worth two or three times as much to the practical

man as the nitrogen in the above mentioned fertilisers, which include some of the best so far known to agricultural science. It is very doubtful whether sludge nitrogen compounds are worth even as much as those in meat meal.

As an inducement to purchase these sludges it is sometimes stated, and quite correctly, that they contain numbers of bacteria, but there is no evidence to show that a farmer should pay more for a manure on this account. All recent work shows that arable soils usually contain as many organisms as they can support, and that the different varieties have settled down to some sort of equilibrium. The only way to increase any special variety appears to be to modify the general conditions in its favour, and so aid it in its struggle for existence. A mere addition of a few organisms may effect a temporary, but cannot bring about a permanent displacement of equilibrium. This statement requires modification for virgin soils or for new leguminous crops, but it is substantially correct for English soils and ordinary English crops.

We do not say that sewage sludges have no value, but it seems to us that they have little practical importance as manures, because only in exceptional circumstances (*e.g.* when they can be had for little more than the cartage) can they compete with the fertilisers at present on the market.

LIME.

During the past few years we have had very many inquiries about the use of lime and the relative values of the different kinds of lime on the market, and this year a definite trial has been made through the kindness of Edwin Ellis, Esq. The results will not be available for some time to come, but they cannot fail to be of the greatest interest and value.

A number of sources of lime are available, including calcium carbonate (chalk), lime ashes, grey stone building lime and grey agricultural lime, white chalk building lime and white agricultural lime, and lime ashes. Further one has to distinguish ground lime and cob-lime. The prices of these various kinds are not regulated by their percentage composition, but by their suitability or otherwise for building and other purposes, and a low priced lime may often be of really better value than one at a higher price. We shall

be in a position to give much more definite advice when the trials on Mr. Ellis's grass land are complete.

Ref. No. 142.

	Total Lime.	Calcium Carbonate.
White chalk building lime	90.30	2.33
Grey-stone building lime	88.64	5.61
White agricultural lime	85.20	1.52
Grey agricultural lime	79.20	5.17

The white is, as usual, better than the grey, but we did not expect to find the grey building lime better than the white agricultural lime.

It is said that the grey-stone lime is better for sandy soils, because it does not readily wash out, but lasts for weeks, destroying grubs and fertilising cereals, roots, etc., while the white chalk lime is not "strong" enough, but disappears at the first rain. We have, therefore, put on one plot 10 cwt. white building lime, on another the same quantity of grey building lime, on a third 10½ cwt. white agricultural lime, and on a fourth 11 cwt. grey agricultural lime: these all contain approximately the same amounts of pure lime.

PHOSPHATIC MANURES.

Several samples of raw phosphates have been sent in for analysis during the past year, and it seems evident that they are seriously being put forward as manure. The samples we have seen have contained about 40 or 50 per cent. of phosphate, and have been very finely ground.

Ref. No.	Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Fineness.
147	23.73	51.81	94.67
597	19.10	41.64	—
140	16.76	36.59	—

No. 140 was from Clear's Farm, Reigate, from the junction of the Gault and Lower Greensand ; No. 147 and 597 were said to be of French origin, and have been extensively offered at 1s. per unit.

In view of the reintroduction of mineral phosphates it is of interest to refer back to the old work on the subject.

The existence of phosphorus in plants was demonstrated during the eighteenth century,* but de Saussure seems to have been the first to indicate its essential nature. Speaking of calcium phosphate as a constituent of bones he says, " J'ai trouvé ce même composé dans les cendres de tous les végétaux ou je l'ai recherché, et nous n'avons aucune raison pour supposer qu'ils puissent exister sans lui."† This statement was amplified by Liebig in his classical " Applications of Chemistry to Agriculture and Physiology " in 1840. .

The value as manure of two phosphatic substances, bones and animal charcoal was, however, discovered quite empirically, and the history of this question forms one of the most interesting chapters in the development of agricultural chemistry. It is impossible to say who first used bones, but in the early part of the last century, during a period when experimental farming was highly fashionable,‡ a number of trials were made in Yorkshire and other places with such excellent results that the demand for bones could not be satisfied by the home supply. By 1825 large shipments were coming from abroad, and it is on record that even the battle-fields of the Peninsular and other continental wars were drawn upon to supply bones for England.§ The times, indeed, were ripe for a phosphatic manure, great improvements in cultivation and management were being effected, larger yields of all crops, and especially of turnips became necessary, and the quantities of dung available no longer sufficed.

* *e.g.* by Polt, by Margraf (*Opuscula Chemica*, i. 68) and by Vauquelin.

† *Recherches Chimiques sur la Vegetation*, an. xii. p. 261.

‡ Young writes : " The farming tribe is now made up of all ranks, from a duke to an apprentice." See also Thorold Rogers, " *Work and Wages*," chap. 17.

§ J. G. Fautier. *De l'emploi des os pilés comme engrais, dans la Grande-Bretagne*, 1830. See also Liebig.

One of the older writers, Worlidge in 1669, attributed the effect of bones to the grease they contained; Payen * attributed it to the gelatine, but both Lawes and Liebig knew before 1840 that the phosphoric acid was the valuable constituent. Sprengel, an eminent botanist, showed that burnt bones, which, of course, contained no gelatine, were also effective, and J. Hannam, a Yorkshire tenant farmer, obtained the same result in field trials in 1842. †

MINERAL PHOSPHATES.

Liebig said that it was a matter of no consequence whether the necessary calcuim phosphate was supplied in the form of bones or of the mineral apatite. Manuring with mineral phosphates was then unknown, but to-day these constitute our chief phosphatic fertilisers. Daubeney and Widdington, in 1844, confirmed the discovery of mineral phosphates at Estramadura, in Spain, and thus opened up the possibility of a large supply for manurial purposes. Their value was demonstrated by field trials in the following year. ‡ Practically none was brought over here, however, owing to difficulties of transport, nor was it necessary, for attention was directed by Henslow, at the Cambridge Meeting of the British Association in 1845, to the deposits of coprolites occurring below the chalk formation in England, and these also were found to be useful manures.

Small amounts of phosphate occur in every soil; large quantities are usually associated with chalk or limestone formations. The beds occurring in Surrey, Cambridge and the eastern counties, at the foot of the chalk, the Lower Greensand and crag have ceased to be of practical importance, having been supplanted by French and Belgian deposits; but the most prolific mines are those of South Carolina, which supply two well distinguished grades. One is obtained from the islands, and is called land phosphate; the other is known as river phosphate and is dredged from the beds of rivers. The former contains some iron and aluminium oxides,

* *Memoirs de la Société Royale d'Agriculture*, 1832, 60.

† *Trans. Highland Agric. Socy.*, 1844. See also Hannam's article on bone manures in *Morton's Cyclopædia of Agriculture*, Vol. 1, p. 257, and the accounts of experiments made by the Morayshire Farmers' Club. *J. R. A. S.*, Vol. 4, 1844, 164.

‡ *J.R.A.S.*, 1845, vii., p. 333.

the latter is much purer and is therefore preferred by English manufacturers. Valuable deposits also occur in Florida and Tennessee. Of recent years the northern African deposits, which are also nearly free from iron and aluminium, have become very important. Supplies come from the Pacific Islands, and deposits are known to occur in other parts of the world, so that there is no immediate prospect of a phosphate famine.*

Phosphates may originally have been formed by the oxidation of phosphides in the igneous rocks, but the present day deposits are of animal origin. Their formation is still going on in some of the Pacific islands. Guano deposited by the birds is mainly nitrogenous organic matter with a certain percentage of phosphate: exposure to the weather causes oxidation of the organic matter and disappearance of the nitrogen, leaving residues which react with the calcium carbonate in the rock beneath to form calcium phosphate. The intermediate stages of this process, while a little nitrogen still remains, yield Phosphatic Guano; the final stages give a pure phosphate, greatly valued for making superphosphates.

There are two other ways in which phosphatic deposits are supposed to have arisen. The true coprolites are the droppings of fish, reptiles and mammals in a more or less fossilised condition, while the other phosphatic nodules may be deposited from solution and arise by the aggregation of phosphate round some centre; the result would be that phosphate previously disseminated through a mass of soil would become concentrated in a single layer. Crystals of apatite† probably form in this way.

MINERAL PHOSPHATES AS MANURE.

Daubeny's trials with Estramadura phosphates have already been mentioned. Paine ‡ at Farnham showed that the phosphatic nodules in and below the chalk had considerable manurial value.

* Owing to enormous consumption of super, six million tons per year for the world—prices of raw phosphates have this year risen, but it remains to be seen whether the rise will be permanent.

† The name apatite is derived from a Greek word meaning to deceive; it was so called because the earlier mineralogists confused it with tourmaline, fluor, beryl and chrysolite. Full accounts of phosphatic deposits are issued by the U.S. Geological Survey.

‡ *Jour. Roy. Agric. Soc.* 1848, Vol. 9, p. 56.

Deherain * made pot experiments with similar deposits in France on soils from Brittany and the Landes, and found that *so long as lime was absent* mineral phosphates were as useful as potassium phosphate.

	Clover.	Lucerne.	Yellow Lupines.
Potassium salts, no phosphate	3.0	2.5	1.35
Potassium phosphate	7.0	6.2	2.2
Powdered mineral phosphate	10.0	9.6	2.2
	Average weight in grams.		

The experience of farmers in these districts also demonstrated the value of mineral phosphates on soils deficient in lime.

This conclusion is borne out by recent pot experiments. Prianischnikoff† finds that even in pure sand lupins can still utilise apatite, though gramineæ fail to do so. Addition of ammonium sulphate, and to a much less extent of ammonium nitrate, greatly increased the availability of the mineral, while in an acid soil mineral phosphate was as good as any other. Somewhat similar results had already been obtained by Söderbaum,‡ working with Swedish moorland soils.

Phosphatic guanos are well recognised manures, and there is no fundamental distinction between these and the mineral phosphates. At the same time mineral phosphates differ considerably among themselves, and partly for this reason, and partly because of the somewhat restricted range of soils and crops for which they are suitable, they have never been very popular, and they are much more important to the manure manufacturer for making superphosphate than to the farmer.

SUPERPHOSPHATE.

This is made by treating mineral phosphates with the calculated quantity of sulphuric acid and consists of a mixture of soluble

* See his "Chimie Agricole," Second Edition, p. 847.

† Landw. Versuchs Stat., 1906, 65, 23.

‡ Jahresbericht ü. Agrikultur Chemie, 1905, 8, 133.

mono-calcic phosphate with gypsum. It was patented in 1842 by Lawes, and was at first made from bone ash and bone char,* later on from the coprolites of the eastern counties, and at the present time from various foreign phosphates.

For high grade super a mineral of the Pacific island type containing 70 per cent. or more phosphate is used, rather strong acid is necessary, and considerable care is required in the process. For the ordinary 26 per cent. grade a weaker acid and a poorer phosphate—50 per cent. or more—can be employed, but all phosphates are not equally suitable. Those containing calcium carbonate are preferred, since the calcium sulphate to which it gives rise absorbs water readily, and forms a dry porous mass easily broken down to a fine powder. The presence of silicates is neither harmful nor beneficial, but the presence of iron or aluminium oxides is considered very objectionable by English makers because the resulting superphosphate tends to “revert,” *i.e.*, some of the phosphoric acid or soluble phosphate reacts with the iron or aluminium sulphate, producing a phosphate insoluble in water, and consequently regarded as valueless by English analysts. On the other hand German and American chemists consider the “reverted” as good as the water soluble phosphate. Fluorides or chlorides are invariably present in the mineral, and give rise to very noxious fumes during the treatment with sulphuric acid. It is considered desirable to leave the mass in a heap for some days or even weeks before finally grinding, a further change apparently takes place, accompanied, it is said, by an increase in volume.

The usual grade in England contains as much soluble phosphoric acid (P_2O_5) as is present in 26 per cent. tricalcic phosphate, and is therefore known as “26 per cent. soluble”; a higher grade, “33 per cent. soluble” is now coming into favour, and a still higher grade, “37 per cent. soluble” is also obtainable. The unit price of the phosphate is the same in each, and, as less quantity is required, there is a saving of freight when the higher grades are used. The lower grades, however, contain more gypsum, and may for this reason be more suitable on light soils deficient in lime; they are also somewhat more bulky.

* See A. D. Hall, Cantor Lectures, 1906, 33, for the history of superphosphate.

Ref. No.	Total Phosphoric Acid.	Equivalent to Tricalcic Phosphate.	Soluble Phosphoric Acid.	Equivalent to Tricalcic Phosphate.
202	13·91	30·36	13·28	29·00
214	16·40	36·07	15·12	33·01

Sample 202 was damp and in bad mechanical condition, a most unusual thing for super. We have not this year had one sample of the old 26 per cent. soluble sent in.

MANURES MADE FROM SUPERPHOSPHATE.

Basic super is made by mixing superphosphate with sufficient lime to render the whole alkaline.

Other manures.—A sample of manure was sent in which had apparently been made by mixing super with a finely ground mineral phosphate; it was said to contain lime, and strictly speaking, it did, but the description was very misleading, as the substance was acid. All three phosphates were apparently present: the mono, soluble in water; the di, soluble only in weak acids; and the tri, less soluble than either. There is no obvious advantage in a mixture of this sort, but if this manure is supplied at a cheaper rate than super, it will be worth trying.

	Phosphoric Acid.	Tricalcic Acid.	
156	20·35	44·46	offered at 57s. 6d.

Until these two manures have been systematically tested, it is impossible to say anything about them.

GYPSUM.

The samples were satisfactory. There is an idea that gypsum prevents mould, and the explanation given is that the sulphur absorbed by the roots acts in the same way as sulphur put on the hop. Some of our hop experiments have shown that gypsum has a certain manurial value, and it may possibly increase or keep up the normal vigour of the plant, and so enable it to resist mould, but the above explanation is certainly incorrect.

FEEDING STUFFS.

LINSEED CAKES.

Ref. No.	Oil.	Protein.	Nitrogen.	Fibre.	Nitrogen free Extract.	Mineral Matter.	Sand.	Moisture.
43	8.03	27.01	4.32	8.58	36.22	6.32	.54	13.84
47	5.57	22.01	3.52	10.08	35.76	11.66	2.77	12.17

Sample 43 was quite a good one and was offered at £8 12s. 6d., but sample 47 was very objectionable. It was called "Pure English Linseed," and the price paid was £7 15s., but it contained an excessive amount of sand and much foreign seed. Badly adulterated cakes like this are not common, but the fact that they do occasionally occur shows the necessity for analysis.

COCOA-NUT CAKE.

Ref. No.	Oil.	Protein.	Nitrogen.	Fibre.	Nitrogen free Extract.	Mineral Matter.	Sand.	Moisture.
49	11.16	18.85	3.08	10.28	40.96	5.72	.25	13.19

The cake was soft and in good mechanical condition: it had a very agreeable odour and taste, and altogether appeared to be very promising. It was offered at £7 7s. 6d., and at this price is certainly good value; though it is not used much in England, it is well spoken of on the Continent.

We understand that the cake is made in England from the residues of cocoanuts from which some of the oil has been extracted. Hitherto the cake has all gone to continental dairy farmers.

Compared with linseed cake, there is a deficiency of protein, but for dairy purposes this could be made up by adding decorticated cotton cake or meal.

MAIZE GERM MEAL.

Ref. No.	Oil.	Protein.	Nitrogen.	Fibre.	Nitrogen free Extract.	Mineral Matter.	Sand.	Moisture.
74	8.26	10.87	1.74	3.10	62.57	2.96	.40	12.30

The sample is a very good one, and is especially low in fibre. The oil and protein correspond almost exactly to the American averages quoted by Henry, though meals richer in protein and with the same oil content are imported into England.

RICE MEAL.

Like maize, rice is very constant in composition, and samples obtained from India, Japan, and the United States showed only slight differences after the shells had been removed.*

The kernel is surrounded by three coats: a fine inner one, rich in protein and in easily decomposed oil, and two fibrous hairy hulls. The outer hulls are first removed, and the product is known as Paddy, or raw rice. It is not yet marketable, however, the thin coat and the germ contain a quantity of oil likely to go rancid and attract insects; they are therefore removed and ground up along with broken rice grains to form rice meal.†

The resulting rice grain is used entirely for human food; it is too costly to be given to stock in this country.

The hulls are not used for food in this country, although a certain amount may be present in the meal.‡ They contain large quantities of fibre and of silica, and the sharp particles present cause irritation of the delicate membranes of the digestive tract.

* Report of Committee of Agriculture, U.S.A., 1879, p. 102.

† For a fuller account of rice and its products see Burchard, Land. Versuchs Stat., 1897, 48, III.

‡ I understand from Mr. Chuidian that they are given to stock in the Philippines.

	Water.	Oil.	Protein.	Nitrogen free extract.	Fibre.	Mineral matter.	Sand.
Ricekernel.	12.4	0.4	7.4	79.2	0.2	0.4	
Rice hulls. † average limits	9.8 12.4-8.9	1.4 1.0-5.2	3.4 2.7-5.9	32.9 25.7-42.7	38.0 26.7-45.2	14.5	10
A good rice meal ..	8.94	13.35	13.74	53.15	4.20	6.62	.72
A good average sample con- tains about	—	12	12	—	not more than 10	not more than 9	—

Kellner found that a large proportion of the nutrients in a good rice meal were digestible, but it appears from the experiments of Lehmann and Vogel that in lower grades the digestibility is diminished, doubtless because of the injurious effect of the hull.

PERCENTAGE DIGESTED.

	Protein.	Oil.	Nitrogen Free Extract.
Good quality (Kellner)†	77.3	88.3	100
Poor quality (Lehmann and Vogel)§	44.5	83.2	83.81

It is considered that the protein in rice has a very high nutritive value. Only about 10 per cent. of the total nitrogen is present in non-protein form.

Rice meal is an excellent and palatable food for all kinds of stock. For pigs it seems to be equal in value to maize meal.|| It can also be fed in conjunction with beans to horses, and with

* Henry, p. 620.

† Pott, Die Landw. Futtermittel, 1889, p. 551.

‡ Land. Versuchs. Stat., 32, 86.

§ Journ. für Landwirthschaft, 1889, 165.

|| See Henry, p. 567.

decorticated cotton cake to cattle and sheep. Unfortunately it tends to become rancid, and is then unpalatable and likely to affect the health and the milk of dairy stock.

Adulterants.—Ground rice hulls are sometimes added, but they are easily detected by the increase they cause in the amount of fibre and of sand, and also by their characteristic appearance under the microscope. Chalk has also been reported, and like the ground hulls, is injurious. Maize meal and other ground cereals are sometimes added.

Ref. No.	Oil.	Protein.	Nitrogen.	Fibre.	Nitrogen Free Extract.	Mineral Matter.	Sand.	Water.
75	13.35	13.74	2.20	4.20	53.15	6.62	.72	8.94

This was offered at £5 2s. 6d.

Other rice products obtained from the bye-products of the rice starch manufacture are occasionally met with.

EDIBLE SEA-WEED.

A sample of edible seaweed was sent in, and was kindly identified by Mr. R. Gepp, of the British Museum, as a mixture of *Chondrus crispus* and *Gigartina Mamillosa*. Unfortunately, the sample was too small for us to divide it into its two constituents, and we made an analysis of the mixture; for practical purposes there is no harm in this since both are edible, and there seems to be very little difference between them except that *Gigartina mamillosa* is said to be more gelatinous than *Chondrus crispus*.

Professor D. Houston, of the Royal College of Science, Dublin, has favoured us with the following notes on this subject:—

“*Chondrus crispus* (carrigeen, or Irish moss) is a sea-weed plentifully distributed along our northern, western, and southern coasts. It is gathered and sold to local chemists, who retail it, in some parts at all events, at 6d. per pound. It is used by many people as an article of food in the west, and generally for colds, for which purpose it is boiled in milk.

“Several of my students tell me that it is used for feeding weak calves and with striking results, bringing about an alteration

of condition within four days. One student tells me that in one case at his own farm a batch of twelve calves took a kind of wasting disease, and nine died ; the other three on the verge of death were given this plant, and all three recovered.

" It is prepared by putting 1-lb. of the ' weed ' in a net bag and boiling in a gallon of water. The water on cooling sets to a jelly. The calves are given one glass of jelly in their milk each meal and wonderful results are said to be obtained."

Moisture.	Ether Extract.	Protein.	Nitrogen.	Nitrogen Free Extract.	Fibre.	Mineral Matter.	Sand.
13.40	2.59	13.06	2.09	54.16	2.57	14.22	.19

The high proportion of soluble mineral matter is noteworthy : but without making a fuller investigation, it is impossible to say precisely wherein lies the value of this sea-weed.

SILAGE.

A sample of maize silage was sent in from Lincolnshire, and on analysis was found to be very similar to our own. There is, in fact, curiously little difference between samples of maize silage produced in different seasons and at different places, and it is easier to give an average composition for silage than for many other succulent feeding stuffs. We do not consider maize silage a useful or profitable food stuff under ordinary conditions, though if swedes or mangolds were impossible, or in other special circumstances, it might prove valuable.

Ref. No.	Ether Extract.	True Protein.	Non-Protein.	Total Nitrogenous Substance.	Nitrogen Free Extract.	Fibre.	Mineral Matter.	Water.
211	.735	1.16	.58	1.74	5.37	3.81	1.40	86.94
	Containing Nitrogen—	18	.10	.28				
Dry matter contained	5.63	8.87	4.35	13.22	41.29	29.17	10.69	
	Nitrogen	1.42	.34	1.76				

The pentosans in the crude silage yielded 1.71 per cent. furfural, and in the dry matter yielded 13.12 per cent.

POISONS.

A number of poisoning cases have, as usual, been submitted to us for investigation. As we have to secure the co-operation of Professor Cave in these cases, it is essential that the whole carcass should be sent as soon as possible, or, if the animal is too big, the stomach at least is wanted. Nothing however, can take the place of a detailed report from the local veterinary surgeon.

In one instance a dog suffered very severely from picking up and eating a pleasant smelling paste which turned out to be a sheep dip!

MILKS.

During the past year 125 samples of milk have been sent in for analysis by forty-four farmers; thirty-two samples, or 25.6 per cent. fell below the legal standard; last year almost exactly the same percentage—26 per cent.—was below. This may partly be the result of bad sampling, but in the main it is probably due to the use of cows giving large quantities of rather poor milk.

Dairy farmers in many districts were seriously incommoded by the long spell of drought last August and September; the cows suffered somewhat, and in consequence the milk often showed abnormal properties. Several samples of milk alleged to be “ropey” or “slimey” came to hand, but they turned out to be free from this disease. Other milks, of which customers had complained, were examined, and the trouble was traced sometimes to the cow, and sometimes could only be assigned to the customer’s dirty jug.

One sample had obviously been adulterated, the percentage of fat was 2.5, and of solids not fat 6.7 per cent.

Three samples of skim milk have been analysed.

Ref. No.	Fat.	Mineral matter.
117	1.05	.74
710	.40	—
710	.35	—

The reduced analytical fee has enabled several farmers to meet charges of adulteration and "watering": samples can be taken for analysis at various points between the milking shed and the customer, and the whole expense is very small.

WATERS.

The two important water-bearing strata of Kent and Surrey are the Chalk and the Lower Greensand, but for local requirements the other strata are also drawn upon. Some formations yield a fairly characteristic water, and it is easy to discover by analysis whether a particular sample has been drawn from the London Clay, the Chalk, the Ragstone or the Weald. But the rule is not general, it is impossible to discriminate between a sample coming from gravel and one coming from a light sand like the Bagshot.

Pure water is, of course, one and the same substance no matter whence its origin; any difference in different samples can only be ascribed to the impurities present. These are of two kinds: organic, arising from the decay of vegetable or animal matter, and inorganic, arising from the soil through which the water has percolated. Organic impurities must be regarded as accidental, they may be present in water from any source, their nature and amount largely determines the suitability of the water for drinking purposes. Mineral impurities are sometimes characteristic, and enable one to fix the stratum from which the water is drawn; so long as the total amount is not excessive, mineral matter is not in itself harmful.

It is quite impossible to fix any limit of purity and say just what amounts of dissolved substance may be tolerated and what may not. The body possesses a great power of adaptation; an agricultural labourer may tolerate throughout a long life, and may even learn to prefer, a somewhat flavoured ditch water which would seriously upset a city clerk or a young child brought fresh into the district. Many of the waters sent in to us for analysis, including some with a great local reputation, would be condemned if we accepted the high standard necessary for a town supply. Such a procedure, however, would be quite impracticable, because no other supplies are available, and quite impolitic, because the villager always refers one to his long-lived ancestors, who consumed the

water before him, without, to their knowledge, suffering any inconvenience.

But although water analysis is not always of great value to the native, it is exceedingly useful to the new-comer, especially to one coming out from the town and accustomed to a pure supply. The local reputation of the water is no guide to him, and may in fact be very misleading; he runs considerable risk of dyspepsia and other troubles, and children or invalids may suffer greatly. Organic matter may be removed or rendered harmless by the proper use of a good filter, but the inorganic constituents to which these troubles are often due *cannot be removed by any practicable means, filtering and boiling are alike useless for the purpose.*

A description of some of the waters may be useful.

Gravel.—When far removed from sources of pollution, gravel waters may be sufficiently free from organic matter, but when, as not uncommonly happens, a village is crowded on to a gravel patch, and wells, cesspools and drainage pipes mingle indiscriminately, the permeability of the gravel facilitates contamination, and the water becomes very impure.

In a good gravel water the inorganic constituents are not high in amount, but where the gravel is capped with clay, the soluble matter increases considerably, sometimes to a dangerous extent.

Two typical analyses are :—

	Good Water, safe for drinking (Bagshot beds; well 60 ft. deep.)	Bad Water, dangerous for drinking (gravel; well 25 ft. deep.)
Free Ammonia	·006	·027
Albuminoid Ammonia	·013	·033
Nitrites - - -	nil	quantity
Nitrates - - -	3·42	7·86
Chlorine - - -	7·0	10·2
Oxygen absorbed -	·038	·118
Hardness - - -	12·11	45·2
Total solids - -	39·08	63·26
Parts per 100,000.		

Bagshot beds.—These are very light and permeable, and yield water not essentially different from gravel waters. If the well

is deep, most of the organic matter is removed, but there often remains an excessive amount of inorganic matter which cannot fail to be harmful; 60 or 70 parts of total solids per 100,000 is not uncommon.

London Clay.—These show the characteristic properties of clay waters, a high solid content of over .1 per cent. largely composed of calcium and magnesium sulphates, with so high a proportion of chlorine as would suggest sewage contamination in any other case. Adults accustomed to these waters may continue to drink them, but they are utterly unsuitable for children. Boiling effects no improvement, the only possibility is to collect and use rain water.

				Well 15 ft. deep.
Free Ammonia	-	-	-	.004
Albuminoid Ammonia	-	-	-	.019
Nitrites	-	-	-	trace
Nitrates	-	-	-	5.704
Chlorine	-	-	-	17.7
Oxygen absorbed	-	-	-	.20
Hardness	-	-	-	30.64
Total solids	-	-	-	117.28

Another sample gave as much as 161 parts of total solids.

Chalk.—The chalk furnishes an abundant supply of pure water, which is being drawn upon so extensively that the water level is falling and in time the land must begin to suffer.* The total solids are usually about 30 to 40, more than half being chalk; little chlorine is present and as a rule organic matter is pretty thoroughly destroyed, especially if the well is deep. The oxygen absorption figures are low, but the amount of nitrate may be proportionately high, it fluctuates, however, even in the same water, for nitrates are relatively unstable and are decomposed by organic matter.

* In a Report presented to the Water Committee of the London County Council, February, 1903, on the shrinkage of the Thames and Lea, Mr. Fitzmaurice, the chief engineer, shows that the water level of the chalk under London is falling at the rate of twelve to eighteen inches per annum.

	Deep Well.	Good Water.	Shallow Well.	Bad Water.
Free Ammonia - -		·003		·012
Albuminoid Ammonia -		·006		·018
Nitrite - - -		nil		trace
Nitrate - -		·308		·028
Chlorine - -		2·4		2·5
Oxygen absorbed -		·04		·16
Hardness - -		21·5		16·43
Total Solids - -		33·76		49·46

Gault.—Owing to its narrow outcrop the gault is of little significance as a source of water : in any case the water obtained is not particularly pure. Some samples contain a fair amount of ferrous salts in solution.

	Good Water.	Suspicious Water.
Free Ammonia - -	.009	.0056
Albuminoid Ammonia -	.009	.02
Nitrate - - -	nil	nil
Nitrite - - -	nil	.428
Chlorine - - -	3·8	4·4
Oxygen absorbed -	.093	.20
Hardness - - -	19·6	30·32
Total solids - - -	31·64	53·00

Lower Greensand.—In recent years this formation has furnished enormous supplies of pure water and is now a very serious rival to

the chalk. There is considerable variation in the amount of solid matter present, some of the deep well waters in Kent contain as little as 30 parts per 100,000, while in other places the amount is 70 or more. In Surrey the dissolved matter is less than 30 as a rule. It is not easy to account for these differences, for the hardness does not vary to anything like the same extent, but, on the other hand, great uniformity cannot be expected in waters obtained from a formation like the Lower Greensand. Definite Ragstone waters have a solid content of 60 or 70 parts, with a hardness of about 20 to 25. When a supply with low solid content is obtainable, it usually makes a good drinking water, and the organic matter originally present readily decomposes as the water passes through the soil. If the total solids exceed 50 per 100,000 the water cannot be regarded as safe for children or invalids.

Some samples show a rather higher oxygen absorption than would normally be associated with the small amount of organic matter present, this is due to the relative large quantities of ferrous compounds, which, together with chalk, are held in solution mainly as bicarbonates. On leaving the water to stand, bubbles of carbonic acid appear on the side of the vessel, and simultaneously a reddish brown deposit containing iron and lime is produced.

		Good Sample. Boring 600ft. deep. Charing.	Ragstone. Sample with excess of Solid Matter. Yalding.	Surrey Water.
Free Ammonia	-	·012	·006	·006
Albuminoid Ammonia	-	·007	·008	·013
Nitrites	- -	nil	trace	trace
Nitrates	- -	nil	·069	·077
Chlorine	- -	2·0	8·41	2·0
Oxygen absorbed	-	·016	·025	·093
Hardness	- -	22·69	24·82	18·02
Total solids	- -	31·92	72·56	28·18

Weald.—Of all the waters we receive none are so bad as those coming from the Weald. The solid content rises to .3 and sometimes .4 per cent., indicating an enormous amount of soluble matter in the soil, in fact the Weald may be regarded as the nearest approach to an “alkali region” that we have in England. The hardness is always high, and sometimes rises to the extraordinary amount of 100 or more : chlorine may be as high as 50. Only rarely is a Weald water fit for drinking, the only reliable source of supply is rain water.

		Bad Water. Well 60 ft. deep.	Good Sample, yet unfit for drinking.
Free Ammonia	- -	.074	.015
Albuminoid Ammonia	-	.026	.009
Nitrites	- -	nil	nil
Nitrates	- -	nil	.154
Chlorine	- -	35.3	27.0
Oxygen absorbed	-	.495	.08
Hardness	- -	114.3	29.04
Total solids	- -	404.8	147.76

Hastings Beds.—As the sands in this series alternate with clay the waters obtained are intermediate in type between the typical sand waters obtained from the Lower Greensand in Surrey and the typical clay waters obtained from the London Clay or Weald. The solid content is not usually less than 50, and rises to over 100 as the soil becomes definitely clayey ; and the chlorine is high. It is impossible to distinguish the waters from these sandy strata with certainty from those arising from Lower Greensand.

There exists, however, a supply of water of very low solid content, which is tapped in the deep well at Goudhurst. Only one other sample of similar composition has been sent in, and in that

case it was not clear whether the water had percolated through the soil or was simply surface water.

			Good Water. Goudhurst.	Wadhurst. Clay Water.	Deep boring. Goudhurst.
Free Ammonia	-	-	.003	.0012	.009
Albuminoid Ammonia	-		.006	.012	.009
Nitrites	-	-	nil	trace	nil
Nitrates	-	-	1.33	2.25	.114
Chlorine	-	-	9.1	12.3	2.8
Oxygen absorbed	-	-	.076	.22	.075
Hardness	-	-	16.43	45.38	9.14
Total solids	-	-	49.1	111.58	12.66

A sample of water from this formation was found to be alkaline : with a total solid content of 85.40, the hardness was only 2.60. Mr. Cousins made a complete analysis of the total solids, and his figures are transcribed in the First Analytical Report, 1893.

39 and 5 (see next page) are both from Ashford, and are practically identical in composition, although the samples were taken in different years and at points one and a half miles apart.

174 *a* and *b* are both ragstone waters : *b* is from a well 45ft. deep ; drains pass near it and there is a cesspool within 20ft.

42 is a pond water which had been used for animals ; something had gone wrong with them and the water was blamed. It certainly was bad, but animals have wonderful powers of tolerating bad water.

29 was intended for drinking purposes : when it reached us it was full of water fleas and other insects. The amount of organic matter was, however, small, and the chief trouble arose from the hardness and the large amount of solid matter.

Ref. No.	Total Solids.	Hardness.	Nitrogen as Ammonia.	Nitrogen as Albuminoid Ammonia.	Nitrile.	Nitrate.	Oxygen Absorbed.	Chlorine.	Formation.
39	38.84	28.7	.0066	.0132	nil	.061	.004	3.0	Lower Greensand
5	43.10	29.7	.010	.014	"	.021	.0273	3.4	"
174a	63.68	39.0	.0026	.005	"	.87	.08	3.10	Ragstone
b	45.2	19.2	.0042	.006	"	1.4	.0104	6.05	"
717	90.7	23.7	.0066	.0093	"	1.008	.068	20.2	? Gravel in Weald
41	19.74	13.57	.008	.0132	"	.052	.030	2.10	Pond water
42	35.76	21.14	.106	.0332	trace	.46	.19	3.5	"
29	47.88	26.00	.0053	.016	nil	1.05	.060	4.05	"
177	58.72	27.9	.005	.002	trace	1.26	.09	8.9	Chalk or Gault

SOIL ANALYSES.

BY ARTHUR AMOS, B.A. (Cantab.), and EDWARD J. RUSSELL,
D.Sc. (Lond.)

The number of soil samples sent in for analysis this year has been very considerable, and we are pleased to find that there is a larger increase in this department of our work than in any other. A knowledge of the requirements of his soil is of fundamental importance to every farmer ; without this it is impossible to draw up a proper scheme of manuring.

A complete report on the soils of Kent and Surrey is in course of preparation, and will be issued as soon as it is ready. In the present report we shall deal only with the samples analysed this year, adding a few general remarks in order to make the analyses intelligible.

Kent and Surrey are ideal counties for the purposes of a soil survey. The geological formations are rarely obscured, and then only by river gravel ; such changes as occur in passing from one end of the counties to the other are fairly regular, and the interpretation of a soil analysis is not complicated by any great diversities in the physical features of a particular formation. The problem presented to the analyst is very simple compared with that furnished by counties where glacial drift is abundant, where one and the same geological formation may at one place lie high and be valueless for agriculture, and at another be highly fertile owing to a much more favourable situation.

Agriculturists divide soils up into several classes—sands, loams, clays, etc. The division is not suitable as the basis of a soil survey, which must be based on geological and physical considerations, but it is nevertheless much too useful to be ignored.

Certain properties are, for instance, common to all sands, whatever their geological formation, but all sands do not exhibit these properties to the same extent. We shall find it most convenient for our present purpose to take the typical properties first, and then passing on to the different samples with which we have to deal, we can see to what extent they conform to the general type. We will first take the sandy soils.

SANDY SOILS.

These soils are mainly composed of particles varying from 1 mm. to .01 mm. in diameter, and included in the groups coarse sand, fine sand, and coarse silt. The amount of clay and fine silt is, in fertile soils, usually about 10 or 12 per cent. ; in barren soils it is much less, and may amount to 2 or 3 per cent. only. Few productive soils contain as much as 40 per cent. of coarse sand.

The main factor in determining productiveness is the water supply. In the absence of much clay these soils are very permeable to water, and their value depends to a large extent on their situation and on the nature of the underlying soil. If this is coarse or pebbly the drainage will be excessive and the surface soil will be too dry for ordinary farming, though it may be very valuable to the market gardener with large quantities of dung at his disposal. If the underlying soil is clay, forming a basin-shaped depression so that there is no drainage, then water will accumulate, the soil becomes water-logged, peaty, and acid, useless alike to the farmer and market gardener until drainage has been attended to and a sufficient amount of lime applied. But if the situation is such that there is good, but not excessive drainage, or if the soil is very deep and becomes somewhat finer in texture as it deepens, then the water supply below the top inch or so is usually satisfactory, sometimes remarkably so, and good crops can be obtained provided growth has started sufficiently early for the roots to have gone well down before the dry weather sets in. Early sowing, and careful use of nitrate of soda, are very effective in bringing this about: the gardener must in addition thoroughly enrich the lower depths of soil, and may even bury much of the top spit with this object.

The most productive of these soils are situated on the lower parts of long, but not too steep, inclines, where the drainage water from the upper land flows through sufficiently near to the surface to reach the plant roots without actually flooding the soil. This drainage water often contains quantities of plant food and is capable of sustaining life and growth of the plant for some time : the whole process constitutes a natural and valuable sub-irrigation. Speaking generally, showery seasons are best for these soils, especially for the lighter ones.

The water holding capacity of these soils may be increased by applying clay, or by adding organic matter, the latter being practised much more frequently than the former. Dung is the commonest, and when cheap, the most valuable substance to add, though when applied very late or in an unrotted condition, it may open up the soil too much and bring about a loss of water. Fish guano and similar substances often give remarkable results. Ploughing in green crops, lupins, mustard, etc., and feeding sheep on the land, are other useful ways of increasing the amount of organic matter.

Another consequence of the low proportion of fine particles and of organic matter is that soluble plant food rapidly washes away. Small dressings of manure frequently applied give the best returns ; late folding is better than early folding ; and dung should go on close to the time of planting, but not late enough to open up the soil. Throughout autumn and early winter the land should be covered with a growing crop to take up nitrates and other soluble substances, and prevent them being washed away. The crop can then be fed or ploughed in, and will slowly decompose with formation of compounds containing the absorbed food materials, which will thus be kept over until wanted by the next crop. In gardens, annual weeds may be left growing till February, when they should be dug in ; on the farm catch crops may be sown after harvest, provided the soil is sufficiently moist to allow the seed to germinate.

A further consequence of the low proportion of fine particles is that the soil can be worked very soon after rain without any fear of injuring its mechanical condition. The value of this property is obvious. As the proportion of fine particles increases the soil

can no longer be treated in this way, or it forms hard, steely lumps which only break down with difficulty. There is no tendency to crack, and but little to form a crust on the surface until the clay and fine silt exceed about 10 per cent. of the whole. The good mechanical condition also prevents the loss of a season, which sometimes happens on stiffer soils : even if one crop fails a tilth can always be secured to put in another. There being no deflocculating action to fear, liquid manure, sewage, mineral manures, have no injurious effect.

Owing to their low water content the specific heat of these soils is low ; they readily become warm in spring and reach a comparatively high temperature in summer. Crops make an early start, but, being insufficiently supplied with water, they rapidly mature : they are early, but not large. Early fruit, early potatoes, and early market garden produce are all obtainable in suitable situations. The tendency to produce small early crops renders these soils unsuited for grass : they will therefore not profitably carry sheep in summer, though they will in winter.

The general conditions obtaining seem well suited to certain crops, like potatoes, malting barley, and carrots, flax also used to be grown ; wheat does not do so well. The natural flora is generally formed by small leaved xerophytes, adapted to little transpiration, or calcifuges. It includes spurry, lupins, gorse, serra della, broom, heather, bracken, many conifers, and holly.

These soils are very liable to form a pan, which must periodically be broken or it will interfere with the water supply.

Chemically these soils are characterised by a high proportion of silica and insoluble silicates, and a low proportion of all the substances wanted for plant nutrition. Less than 4 or 5 per cent. of organic matter is present even in the black peaty sands, and the depth of colour arises from the comparatively small extent of surface over which it is spread. The amount of nitrogen is consequently low, and rarely much exceeds .1 per cent.

There is almost invariably a deficiency of lime, a fact which is clearly indicated by the presence of calcifuges among the native flora and by the prevalence of club on turnips and cabbages. It was one time the custom to apply heavy dressings of lime or chalk at long intervals : smaller dressings more frequently applied

would probably be better. Owing to the lack of lime, superphosphate and sulphate of ammonia should not, as a rule, be used.

Potash manures have a marked effect. We have already seen that potash tends to prolong the life of the plant ; on these soils it therefore counteracts the general tendency of the prevailing conditions to hasten the ripening processes, and to stop growth at an early period. Only small quantities are naturally present.

Sodium compounds are present in larger amounts, but salt has long since been profitably used as manure on these soils, doubtless because of the general resemblance in action between sodium and potassium compounds. Salt is said by the practical man to retain moisture, but the evidence is against this view.

The amount of iron present is less than one would suppose judging by the red colour.

The activity of the micro-organisms in these soils seems to be less than in most others.

In drawing up a scheme for the manurial treatment of these soils it must always be remembered that the main deficiency is water. Organic matter must therefore be added, but not in greater quantities than the soil organisms can decompose. Excessive dunging is unprofitable, and may even be injurious. Lime facilitates decomposition and must therefore enter into the scheme, and potash is also wanted because of its favourable action on the crop. Kainit is perhaps better than sulphate, since the sodium present is useful ; ashes from bonfires are also valuable. Two or three small dressings of nitrate of soda are very effective in enabling the plant to form deep roots and so get beyond the surface layer of soil. Phosphatic manuring is not usually necessary, excepting for swedes and malting barley, perhaps owing to the ease with which root development naturally takes place. Steamed bone flour or cheap meat meal may be periodically added to maintain productiveness. In no case should large dressings of manures be recommended. A scheme which is quite sound in principle may well turn out too costly in practice.

Bagshot Beds.

Scattered about on the London clay in Surrey, particularly in the broad strip of fertile country lying between London and

Guildford, are patches of a light sandy soil which under favourable conditions are capable of producing good early crops of potatoes and other market garden produce. These patches are outliers of the Bagshot sands, and their value depends entirely on their situation; if they happen to be in saucer-shaped depressions of the clay, they become water-logged, acid, and sterile, while if they are so placed that drainage is good, but not excessive, valuable crops can be produced.

Mechanical Analysis.

	Barren Patch. Tolworth. 106.	Good Soil. Claygate. 104.
Stones (above 3 mm. diam.) - - - -	3.37	3.29
Gravel (3 mm. to 1 mm.) - - - -	1.52	.57
Coarse Sand (1 mm. to 2 mm.) - - - -	44.23	16.80
Fine Sand (.2 mm. to .05 mm.) - - - -	25.24	44.99
Coarse Silt (.05 mm. to .01 mm.) - - - -	7.82	13.87
Fine Silt (.01 mm. to .005 mm.) - - - -	3.84	4.41
Clay (below .005 mm.) - - - -	6.48	8.82

Sample 106 is remarkable for the large amount of coarse sand present: we do not know of any soil with 40 per cent. of coarse sand which can be relied upon to produce farm crops. This field is only a few yards distant from the very heavy soil No. 96: it is in the occupation of a very first-class farmer, but by no profitable means can it be made productive.

No. 104 is much better in texture; there is a greater quantity of fine sand and much less coarse sand: as a result water does not percolate so freely through the soil, though the drainage is quite sufficiently good. It is impossible to work this land during the winter months.

At one time this soil produced excellent white wheat: it was also good for other straw crops, but for the last ten years it has

been rather poor permanent pasture, and is now being broken up. The subsoil shows grey streaks of clay with yellow streaks of sand.

Chemical Analysis.

	Barren Patch. 106.	Claygate. Good Soil. 104.	Clandon Common. 115.	
			Good ridge.	Bad portion.
Moisture - - - -	1·59	2·42	2·88	2·38
Loss on ignition - - -	3·60	3·41	7·11	5·78
Nitrogen - - - -	·182	·150	·24	·20
Calcium carbonate - -	·27	·09	·37	·08
Potash extracted by hydrochloric acid - - - -	·207	·230	—	—
Potash extracted by 1 per cent. citric acid - - - -	·0134	·009	·0155	·0167
Phosphoric acid extracted by hydrochloric acid -	·0894	·0652	—	—
Phosphoric acid extracted by 1 per cent. citric acid -	·0224	·0125	·0134	·0086

Nos. 106 and 104 afford excellent examples of the difficulties of interpreting a soil analysis. No. 104 is known to be much the better soil, yet it comes out poorer in practically every respect than No. 106. There is, however, no anomaly here, for the mechanical analysis affords a complete explanation of the discrepancy: it is well established that the cultivation of soils of unsuitable texture is very expensive, and that no amount of plant food will make a soil productive unless the water supply is good.

No. 115 is from a pasture on what used to be Clandon Common. The sand fills a saucer-shaped depression in the clay, and produces satisfactory herbage at one end of the field near a stream, and also towards the middle, where the ground rises somewhat. But at

the far end there is a dip and water cannot get away ; in consequence the herbage is very unsatisfactory. Obviously no improvement is possible until a way out is made for the water ; when this has been done, lime and phosphoric acid must be added to the bad part in order to bring it up in composition to the good. Neither good nor bad parts, however, are particularly rich in plant food, and with so good a water supply it might very probably pay to give a complete manurial dressing to the whole ground.

Oldhaven and Thanet Beds.

These form excellent hop and fruit soils so long as the water supply is satisfactory. They are naturally deficient in plant food, but high manuring is general, and the actual amounts of plant food present are high.

	Green- hithe.	Herne Hill.		Barton.		Wickham.	
		G.	C.	1.	2.	1.	2.
Moisture - -	1·63	3·69	2·14	1·75	—	1·82	1·79
Loss on ignition -	4·16	4·62	3·50	3·89	—	4·28	4·07
Nitrogen - -	·10	·149	·102	·168	·144	·199	·186
Calcium carbonate	·25	·21	1·04	·10	·18	·31	·10
Potash extracted by hydrochloric acid - - -	—	·396	·338	·422	·505	·323	·262
Potash extracted by 1 per cent. citric acid -	·022	·0174	·0175	·0167	·0145	·024	·048
Phosphoric acid extracted by hy- drochloric acid -	—	·128	·182	·134	·131	·157	·133
Phosphoric acid extracted by 1 per cent. citric acid -	·021	·0288	—	·036	·048	·057	·0228

For the production of hops these soils require lime and bulky organic manure, especially dung. It is always desirable to try potash manures, but we are not yet able to say whether kainit or sulphate of potash would be most suitable for hops.

The two Wickham soils belong to the Thanet beds; Greenhithe, Herne Hill and Barton are Oldhaven.

An interesting and unusual instance of a fruit plantation showing a well marked fertile portion and an equally well marked infertile portion was investigated. It was found that the poor part was considerably heavier than the other, and we consider the difference in productiveness arises from this cause. There was also a considerable difference in the rate of oxidation of the two soils.

	Good Land.		Bad Land.	
	Surface.	Subsoil.	Surface.	Subsoil.
Stones (above 3mm.) - -	·82	1·37	1·07	·34
Gravel (3 mm. to 1 mm.) -	·67	·25	·98	·13
Coarse Sand (1 mm. to .2 mm.)	1·46	1·21	1·90	·47
Fine Sand (.2 mm. to .05 mm.)	51·45	51·43	46·73	49·30
Coarse Silt (.05 mm. to .01 mm.)	18·94	20·30	14·06	14·58
Fine Silt (.01 mm. to .005 mm.)	5·85	3·79	4·01	3·36
Clay (below .005 mm.) -- -	9·66	13·49	14·39	19·97
Calcium carbonate - -	·18	—	3·49	—
Moisture - - -	2·81	2·75	3·91	4·14
Loss on ignition - - -	6·71	3·81	8·22	4·65

The Folkestone Beds.

The strip of very light sandy soil lying next to the gault is known as Folkestone sand; it constitutes some of the poorest

soil in Kent and Surrey, only the part close to the gault is fertile, the rest has usually been left uncultivated as open common, park or woodland. It produces only one important economic product the Spanish chestnut, which, when grown on this formation is considered better for hop poles than when grown on any other.

Some of the wildest and most romantic country in Kent and Surrey is found on this formation and on the Hythe beds. In the present generation it has become very popular for building sites, partly on account of the surrounding scenery, and partly because of the good natural drainage, and the soil which farmers found difficult or impracticable to bring into cultivation has now to be cultivated by gardeners.

The nature of the problem is of course changed, and economic considerations no longer have the chief place ; if the natural flora is preserved as at Haslemere, very delightful effects can be produced at small cost, but if a formal garden is desired containing all sorts of plants not adapted to the soil, it becomes necessary to spend a certain amount of money in order to modify the natural conditions. The general principles already given must be applied in framing a scheme of management.

The enormous effect of organic matter in increasing the water holding capacity of the soil is seen in the following analysis of a garden soil :—

	Surface Soil. Rich in organic matter.	Sub Soil. Pure Sand.
Water holding capacity - - - -	53·5	28·7
Calcium carbonate - - - - -	1·62	·08

Clay is prevalent notwithstanding the large amount of calcium carbonate.

Mechanical and chemical analyses of some productive Folkestone soils near Nutfield are given :—

Mechanical Analysis.

	101.		102.		103.	
	Surface.	Subsoil.	Surface.	Subsoil.	Surface.	Subsoil.
Stones (above 3 mm.) - - -	5·63	5·32	3·64	5·97	·66	·26
Gravel (3 mm. to 1 mm.) - -	3·95	3·66	3·61	6·02	2·51	1·54
Coarse Sand (1 mm. to 2 mm.)	26·38	25·37	35·65	33·19	10·72	8·12
Fine Sand (.2 mm. to .05 mm.)	38·76	37·74	29·85	29·15	28·66	26·97
Coarse Silt (.05 mm. to .01 mm.)	6·63	6·88	10·27	9·46	29·84	28·02
Fine Silt (.01 mm. to .005 mm.)	4·16	3·73	3·62	3·91	8·52	7·27
Clay (below .005 mm.) - - -	6·94	10·80	6·19	6·89	10·53	17·54

Chemical Analysis.

	101. Surface.	102. Surface.	103. Surface.
Moisture - - - - -	1·69	3·64	2·61
Loss on ignition - - - - -	4·73	3·61	4·51
Nitrogen - - - - -	·189	·147	·184
Calcium carbonate - - - - -	·072	·212	·072
Potash extracted by hydrochloric acid	·398	·388	·288
„ „ 1% citric acid	·0206	·012	·012
Phosphoric Acid extracted by hydrochloric acid - - - - -	·230	·144	1·53
„ „ 1% citric acid - - -	·013	·040	·0253

These three soils were dealt with in the last report and little need be said here ; No. 101 is grass land, and the other two are

arable land. No. 103 is particularly productive, but the explanation is to be found in its mechanical texture and its situation rather than in its chemical composition. It lies at the bottom of a slope and therefore has an excellent water supply: No. 102 lies higher up and has a smaller supply, it is also coarser in texture and less able to retain moisture.

Hythe Beds.

In Kent these are very productive, and afford some of the best soil in the county, but in Surrey they are less satisfactory, and much of the land on this formation is uncultivated. In the Guildford district there is a very fertile patch known as the Bargate soil; one or two other fertile patches are found, but they are rather exceptional.

Mechanical Analysis.

	East Farleigh, Kent.		Little Chart, Kent.	Shalford, Guildford.	
	"Upper Field"	"Farfield"		1	2
Stones (above 3 mm.) -	7.65	9.19	1.53	5.67	6.98
Gravel (3 mm. to 1 mm.) -	4.26	3.15	1.98	3.57	4.74
Coarse sand (1 mm. to .2 mm.)	14.84	11.52	21.26	59.37	32.97
Fine Sand (.2 mm. to .05 mm.)	19.54	21.10	39.36	14.69	36.81
Coarse silt (.05 mm. to .01 mm.)	19.51	23.80	11.77	5.48	5.88
Fine silt (.01 mm. to .005 mm.)	7.61	6.77	8.13	2.94	3.32
Clay (below .005 mm.) -	12.52	10.81	9.10	2.77	2.91

Chemical Analysis—See opposite page.

Ripton and East Farleigh are hop soils, Little Chart and Shalford produce ordinary crops.

The manurial history of these soils is well reflected in their composition: the hop gardens have received large dressings of dung, shoddy and of phosphates, and in consequence we find

	Ripton, near Ashford.			Little Chart.		East Farleigh.		Shalford. Guildford.	
	F	H	L			Upper Field.	Farfield.	I	2
Moisture - - - - -	—	—	—	2.69	2.31	2.02	2.04	1.03	1.18
Loss on ignition - - - - -	—	—	—	3.01	2.69	5.18	4.46	3.17	3.37
Nitrogen - - - - -	.191	.177	.236	.103	.093	.204	.169	.139	.135
Calcium Carbonate - - - - -	1.16	.36	.20	.10	.07	3.05	3.20	.31	.39
Potash extracted by Hydrochloric Acid - - -	—	—	—	.732	.337	.631	.625	.136	.180
„ „ 1% Citric Acid - - -	.0228	.0206	.0223	.0106	.009	.0317	.0236	.005	.009
Phosphoric Acid extracted by Hydrochloric Acid - - -	—	—	—	.086	.087	.405	.328	.191	—
„ „ 1% Citric Acid - - -	.0530	.0559	.0502	.0114	.0102	.186	.182	.0373	.056

a considerable amount of nitrogen and of phosphates, in fact the phosphoric acid in one of the East Farleigh fields can only be considered enormous.

The Shalford soil responds freely to dressings of lime and of salt, and therefore requires potash. It produces good malting barley.

The Little Chart soil has been worked out by a previous tenant ; such manure as was available was put on to the hop garden, and little or nothing, except a small dressing of superphosphate, was returned to the arable land. It is said that for thirty years no dung has gone on to the land, and practically no food has been carried out to the sheep. There has been a gradual transference of fertility from the rest of the farm to the hop garden, a process which may also be seen going on in other places.

Although these soils are all on the Hythe beds they belong to very different parts of the formation. Ripton and Little Chart are ragstone, East Farleigh is pinnock, Shalford (1) lies on an iron-stone, which periodically works its way in large lumps to the surface, and Shalford (2) is considered to resemble Bargate soil. Both of the Shalford soils are extraordinarily coarse in texture.

LOAMS.

These consist mainly of fine sand and coarse silt, *i.e.*, of particles ranging in diameter from .2 to .01 mm., about 16 to 20 per cent. of fine silt and clay is also present, against 10 or 12 per cent. in the case of a sandy soil.

The larger proportion of fine particles present renders the soil more retentive of moisture and consequently less dependent on its position than is a sandy soil. It is also more sticky when wet, and if worked in this condition it frequently becomes very hard on drying. After heavy rain a cake forms on the surface.

The specific heat is fairly high, and the soils warm but slowly in the spring, though the temperature is sufficiently high in summer. During autumn the soils still remain warm, and crops continue growth late and finish well. Bacterial activity is high.

In drawing up a scheme for manuring these soils care must be taken that the physical condition is not injured. Liquid manure and nitrate of soda both deflocculate clay, and unless sufficient coarse sand is present, they may be unsuitable as a manure. On the other hand lime is a very useful substance to apply, by flocculating the clay it favours the production of a good tilth, and facilitates the movements of air and water in the soil. A small difference in the amount of lime present makes a very considerable difference in the texture of the soil. A loam with 20 per cent. of clay and fine silt, and .5 per cent. of calcium carbonate may be almost unworkable and go out of cultivation, whilst the same soil with 1.5 per cent. of calcium carbonate may work well and give excellent crops.

Organic matter has the same effect.

It has already been stated that plants naturally continue growing late into the autumn, consequently potash is not usually necessary except for special crops like potatoes and mangolds. Sulphate of potash is probably most suitable for the former, and kainit for the latter crop. As a rule it is desirable to shorten the life of the plant, this frequently happens in the case of barley and in cold wet regions in the case of wheat as well; phosphates are therefore needed, and they may be applied as bone manures, meat guanos, superphosphate, or if the soil is naturally wet and sticky, as basic slag.

Nitrogen may be supplied either in organic manures, in sulphate of ammonia if the soil contains sufficient lime, or in nitrate of soda unless this substance makes the soil "unkindly." The large amount of clay prevents the added manures from being washed out, and as the general conditions are favourable to crop production, manures have a very great effect.

From the chemical point of view these soils contain less silica than do the sandy soils, but more of every other constituent. The loss on ignition, which is chiefly organic matter, varies from 4 to 10 per cent.: the nitrogen lies between .15 and .2 per cent., hydrochloric acid extracts .4 to .8 per cent., of potash but if the soil is broken up with hydro-fluoric acid, two or three times this amount can be obtained. Hydrochloric acid extracts about .1 per cent. of phosphoric acid.

CALCAREOUS SOILS.

These may be regarded as loams mixed with 5 to 60 per cent. of calcium carbonate, and in some cases, with a large quantity of flints.

The effect of the calcium carbonate is to greatly increase the amount of bacterial action ; organic matter is rapidly decomposed, and even resistant substances like peat moss and hair quickly disappear. These soils are picturesquely described by the practical man as " hungry " soils. The intense bacterial activity is, indeed, responsible for much of the difficulty of working them.

As in the case of sandy soils production is largely determined by the water supply. The little valleys in the chalk, with deep moist soil, are very fertile, but the thin soils lying higher up are poor. In a showery season, however, they may do well, and few farms show greater improvement after a shower of rain than chalk farms. The water supply in fact is a very serious matter, and it is likely to become more so now that the chalk area is so largely utilised to supply London and other towns and cities with water. It is estimated that the water level in the chalk below London is sinking at the rate of 12 to 18 inches per annum.* and this fall must in time have a serious effect on the productiveness of the soil. The decomposition processes are too rapid for organic matter to last, and the only way in which the water relationships of these soils can be improved is by proper tillage.

The cultivation of a chalk soil is a difficult, and often an expensive matter. In the first place the chronic deficiency in organic matter makes it difficult to get a tilth, and unless skilfully worked, the soil dries into hard, steely lumps, which will not break down. Further, the soil tends to become very foul, and nowhere does the old saying, " One year's seeding brings seven years' weeding," apply so forcibly as on chalk soils. If weeds are not removed they use up the small supply of water, leaving little for the crop. Lastly, it is essential, in order to maintain the proper degree of moisture, that the soil should be kept firm below to secure continuity of water supply, and loose above to check evaporation.

* " Shrinkage of the Thames and Lea." Report to the Water Committee, London County Council, February, 1903.

The chalk farmer has certainly evolved a method satisfying these requirements. In the autumn ploughing the furrow slice is turned right over, so that evaporation is reduced to a minimum ; broadsharing is an excellent method for getting the proper degree of compactness below and looseness above, and frequent recourse must be had to spring rolling. The soil does not long remain compact, winter frosts, and perhaps other causes also, effect an expansion, so that the soil becomes light or " hover." Unless this is counteracted by spring rolling plants get no root hold. Throughout the late spring and early summer surface cultivation is often needed both to preserve a mulch and to keep down weeds.

Cultivated chalk soils may contain as much as 60 per cent. of calcium carbonate ; there is usually about .4 per cent. of potash or less if the soil is thin, and .15 to .2 per cent. of phosphoric acid.

The scheme of manuring will resemble in some respects that adopted for sandy soils. Water is the great deficiency, and organic manures of any description can be used—dung, shoddy, feathers, fur waste, even leather waste and hair are used, though the two latter cannot be recommended. These manures must go on early, if applied late they open up the soil too much and cause too great an evaporation of water. Potash is also needed on thin soils and may be supplied as kainit, this takes the place of the dressings of salt which have long been used on the chalk.

Sheep folding on the land is excellent, both from the mechanical and the chemical point of view ; the treading makes the soil more compact, and the dung adds valuable organic matter. Green manuring would be excellent if it could be practised, but the soil is often too dry after the summer crop to admit of germination, and it is difficult if not impossible to dispense with the autumn cleaning.

Sulphate of ammonia is practically as useful as nitrate of soda, excepting in an emergency—when, for instance, a young oat crop is attacked by wire worm in cold weather.

Superphosphate can be applied for swedes, and for barley.

On grass land a dressing of kainit will frequently encourage clovers ; basic slag is, however, of no use. During winter an abundant growth of moss springs up, there seems no better method than rolling to keep this in check. The improvement of poor chalk

pasture is very difficult. Heavy dressings of manure are not usually profitable.

For generations these soils have been "sheep and barley" soils, and so well do sheep do that the cultivation of turnips was early taken up even though the crop is sometimes difficult to secure. The turnip flea is so prevalent that swedes and turnips can only be relied upon once in six years, and a six course rotation is generally adopted. The pastures are also well adapted to sheep, they are dry, healthy, and cool in summer; the herbage produced is sweet, if not luxuriant, and consists of sheep's fescue and other grasses adapted to dry situations.

Barley does well on these soils, lucerne and sainfoin are excellent crops, and, even in the driest situations, may be expected to do well; timothy and rye grass are useful constituents of a seeds mixture; wheat, on the other hand, is not so good.

The natural flora of the chalk is extensive, and includes a large number of flowering plants, besides beech, yew, mealy guelder rose, dog-wood, wild cherry, etc. Some shrubs and trees do badly, they are stunted in growth and produce white leaves, this effect is more noticeable in some seasons than in others.

Analysis of chalk soils are appended.

Mechanical Analysis.

	Monkton (Thanet).	Wye (7).
Stones (above 3 mm.) - - - -	1.92	5.6
Gravel (3 mm. to 1 mm.) - - - -	1.25	1.26
Coarse sand (1 mm. to .2 mm.) - - -	2.44	20.81
Fine Sand (.2 mm. to .05 mm.) - - -	31.81	23.89
Coarse Silt (.05 mm. to .01 mm.) - - -	25.54	24.24
Fine Silt (.01 mm. to .005 mm.) - - -	5.88	3.70
Clay (below .005 mm.) - - - -	13.66	10.26

Chemical Analysis.

	Monkton (Thanet).	Guildford.	Wye (7).
Moisture - - - - -	3·72	3·27	3·09
Loss on ignition - - - - -	4·36	5·45	3·63
Nitrogen - - - - -	·177	·196	·132
Calcium carbonate - - - - -	7·12	20·56	7·91
Potash extracted by Hydrochloric Acid-	·116	·406	·345
„ „ 1% Citric Acid -	·0024	·0032	·0056
Phosphoric Acid extracted by Hydro- chloric Acid - - - - -	·178	·156	·143
„ „ 1% Citric Acid -	·0157	·0013	·035

CLAY SOILS.

These are characterised by the presence of large amounts—20 per cent. to 50 per cent.—of particles below .005 mm. in diameter, and of only small amounts of particles above .2 mm. in diameter. Water only moves through them with difficulty it cannot drain away in wet weather, but lies on the surface, and it cannot rise from the subsoil in dry weather, hence the soils suffer much from drought even though the water table is close to the surface. These soils shrink very much on drying, and in summer time large cracks appear in the fields.

They have a high specific heat, and therefore produce late crops, but in favourable seasons they are very productive.

At one time these soils yielded profitable wheat and bean crops. A bare fallow was necessary once in four years, and sometimes a year was lost owing to the impossibility of getting on to the land to sow the crop. Eight horses were sometimes needed for ploughing. To-day all this is impossible, the heavier clays are now permanent pasture, and only the lighter ones are cultivated. Wheat, beans, and mangolds do well, swedes, however, do not.

The proportion of aluminium and iron oxides is rather high, and the colour of the soil depends on the state of oxidation of the iron. Ferric oxide produces a red and ferrous compounds a green or blue soil. As much as 4 per cent. of potash is sometimes present, though hydrochloric acid only extracts .5 to 1 per cent. and 1 per cent. citric acid only .01 to .05 per cent. Bacterial activity is not very high, and organic matter does not quickly oxidise, 5 to 10 per cent. is frequently present, and .15 to .2 per cent. of nitrogen. Lime, however, is often deficient, and is wanted both for its physical and its chemical effects. Phosphoric acid is also present in small amounts, .1 per cent., or even less; it must usually be added. A curious feature, and one not without agricultural significance, is the large amount of soluble matter present. The well waters usually contain .1 per cent. or more of total solid matter, and occasionally, as in the Weald of Kent, the amount rises to .4 per cent.

Much of the pasture on the clay is poor, but improvement is less difficult than on very light soils. Basic slag is extremely effective; it, may, however, be necessary to drain, and sometimes to sow clover seeds.

Three Weald soils have come in for analysis:—

Mechanical Analysis.

	Bethersden.		East Sutton.	Horley.
	1.	2.		
Stones (above 3 mm. diameter) - - -	.55	.56	1.86	.26
Gravel (3 mm. to 1 mm. - - -	1.87	2.58	1.41	1.08
Coarse Sand (1 mm. to .2 mm.) - -	3.23	2.30	2.85	3.08
Fine Sand (.2 mm. to .05 mm.) - -	8.38	9.82	15.89	7.17
Coarse Silt (.05 mm. to .01 mm.) - -	21.38	25.00	28.37	42.13
Fine Silt (.01 mm. to .005 mm.) - -	23.93	22.40	19.28	14.91
Clay (below .005 mm.) - - -	22.67	23.94	17.86	16.82

Chemical Analysis.

	Bethersden.		East Sutton.	Horley.
	1.	2.		
Moisture - - - - -	4·87	4·19	3·81	4·15
Loss on ignition - - - - -	9·24	7·25	6·24	6·23
Nitrogen - - - - -	·20	·18	·187	·261
Calcium Carbonate - - - - -	·84	·55	·01	2·14
Potash extracted by Hydrochloric Acid	·584	·821	·563	·584
„ „ 1% Citric Acid -	·0109	·0728	·023	·0104
Phosphoric Acid extracted by Hydrochloric Acid - - - - -	·143	·099	·064	·135
„ „ 1% Citric Acid -	·014	·0096	·0055	·0146

The Horley soil is in cultivation, but occasional summer fallowing is needed to clean the land. The others are all pasture.

LONDON CLAYS.

Several samples have been taken in Surrey.

Mechanical Analysis.

	Tolworth. 107.	Chessington. 105.
Stones (above 3 mm. diameter) - -	2·12	1·55
Gravel (3 mm. to 1 mm.) - -	·61	·80
Coarse Sand (1 mm. to .2 mm.) - -	16·18	22·60
Fine Sand (.2 mm. to .05 mm.) - -	20·88	26·63
Coarse Silt (.05 mm. to .01 mm.) - -	15·56	16·66
Fine Silt (.01 mm. to .005 mm.) - -	8·63	6·36
Clay (below .005 mm.) - -	20·76	14·10

Chemical Analysis.

					Tolworth. 107.	Chessington. 105.
Moisture	-	-	-	-	4.92	2.92
Loss on ignition	-	-	-	-	5.61	4.29
Nitrogen	-	-	-	-	.241	.147
Calcium Carbonate	-	-	-	-	2.00	.88
Potash extracted by Hydrochloric Acid	-				.598	.440
„ „ 1% Citric Acid	-	-	-		.0155	.0109
Phosphoric Acid extracted by Hydrochloric Acid					.1213	.0968
„ „ 1% Citric Acid	-				.0187	.0239

No. 107 is a yellowish-red clay, which cracks badly in dry weather, it is the stiffest sample of London clay which has reached us from Surrey, with the single exception of a soil from Ashtead Common. It is cultivated, and has in the past been heavily chalked, but the lumps are now about twelve inches down.

No. 105 is fairly typical of the London clay in Surrey ; it is grey in colour, with bands of red, the mechanical analysis shows that there is a considerable admixture of sand, and the soil is really a stiff loam. It was excellent for wheat, and now gives good late potatoes.

CLAY WITH FLINTS.

This clay-with-flints lies on the chalk, and is found throughout Kent and Surrey. It is generally supposed to have been formed from the residues of other formations, and not itself to be a distinct geological formation. The highest parts are either woodland or pasture, but at lower altitudes good crops can be produced, and a certain amount of profit can also be derived from the flints which

are picked off the soil. In Surrey much of the land is now in grass for dairy farming, and some is also used for building purposes, and such cultivation as takes place is transferred from the farmer to the gardener. In Kent, however, this soil is extensively farmed for ordinary crops, and, in favourable situations, for fruit.

The soil is a distinct clay, and a good garden can only be obtained by careful management. Land which the farmer lets alone, if he can, is not going to be converted into a garden all at once. An over-zealous amateur may, in a few short weeks, hopelessly ruin his land for years. Perhaps the most prolific source of trouble is the very laudable desire to thoroughly trench the ground, to bury the top soil, and to bring up the bottom spit. *We do not know of any case where this plan has succeeded, in our experience it always leads to disaster on this formation.* The subsoil is quite unsuited for plant growth, young plants do badly right from the beginning, and if they do not die off altogether, they only survive as poor stunted specimens.

Trenching must, of course, be done, but the bottom spit must be kept at the bottom with dung worked in, and the top spit kept on top.

A second source of trouble arises from the desire to use artificials only, and no dung. We cannot at all recommend this plan. Organic manures are very necessary, and in the flower and kitchen garden there is probably nothing better than dung ; on the lawn, fish guano may be used instead.

Much disappointment also results from the introduction into the garden of rare or unusual exotics. A piece of land which has gone out of cultivation, and has for years been a poor lucerne ley or a worse pasture, is "thoroughly" trenched, and into the sticky, unkindly soil some rather delicate plants are set. Naturally they fail. The proper course is to begin with hardy varieties of such sturdy plants as hollyhocks, delphinium, geum, Michaelmas daisy, wallflowers, pinks especially "Mrs. Simkins," and many sorts of bulbs. Constant surface cultivation and proper manuring will in time bring the soil into excellent condition, so that more expensive varieties may be tried with some prospect of success. A study of the native woodland will suggest many things likely to succeed in a wild garden.

"Clay with Flints" Soils.

Mechanical Analysis.

	108. Kenley.	109. Hams'y Green.	110. Hams y Green.	111. Couls- den.	180. Loyterton, Kent.	
					1	2
Stones (above 3 mm.) - - -	16·13	10·08	7·14	8·90	10·42	1·14
Gravel (3 mm. to 1 mm. - - -	1·43	1·62	2·53	1·79	1·79	·83
Coarse Sand (1 mm. to .2 mm.) -	20·62	9·59	8·26	8·62	1·31	1·15
Fine Sand (.2 mm. to .05 mm.) -	15·34	22·36	23·31	21·68	20·92	25·82
Coarse Silt (.05 mm. to .01 mm.) -	21·29	25·48	26·30	20·52	32·28	42·51
Fine Silt (.01 mm. to .005 mm.) -	7·33	7·51	7·97	7·73	6·47	7·20
Clay (below .005 mm.) - - -	10·65	12·20	14·77	16·76	15·68	11·41

Chemical Analysis.

	108. Kenley.	109. Hamsey Green.	110. Hamsey Green.	111. Couls- den.	180. Loyterton, Kent.	
					1	2
Moisture - - -	2·42	2·85	2·95	3·78	3·37	2·55
Loss on ignition - - -	3·92	5·27	4·88	5·56	5·36	4·76
Nitrogen - - -	·154	·20	·174	·180	·182	·173
Calcium Carbonate -	·40	·48	1·02	·57	·76	·74
Potash extracted by Hydro- chloric Acid - -	·211	·292	·370	·393	·110	·286
,, ,, 1% Citric Acid	·0065	·0094	·0065	·0069	·0032	·0042
Phosphoric Acid extracted by Hydrochloric Acid	·107	·117	·158	·127	·111	·095
,, ,, 1% Citric Acid	·0068	·0114	·0058	·0075	·017	·0247

These soils are all deficient in lime, potash and phosphoric acid. The old manurial treatment was to give a heavy dressing of chalk periodically: pits were sunk in the fields till the chalk was reached, and then fifty or sixty tons per acre was laid on the land. In some places, *e.g.*, in Hertfordshire, bones were also applied. The modification now recommended is to use about 15 cwt. lime every four years, periodically to add sulphate of potash, and either steamed bone flour, or else superphosphate. Dung is, of course, essential.

108. This is the lightest of the series, the soil is easy to work, does not become steely, and easily drains. There were so many flints that it was difficult to take a sample.

109 is reputed to be the stiffest soil in the district, and has long been laid down to permanent pasture. It easily becomes water-logged.

110 is from an adjoining field said to be much easier to work, and therefore kept arable. In reality it is stiffer than the preceding soil, but as it contains double the quantity of calcium carbonate, it is in better mechanical condition. It is very productive. Basic slag is used with good effect, but super is found to be injurious.

These two fields furnish a very interesting example of soils which appear to be widely different in texture, and yet are identical. No two fields could differ more in agricultural history, one has gone out of cultivation, and the other yields excellent crops. There may have been a difference in the original method of drainage, but the only difference we have been able to discover is a half per cent. of calcium carbonate.

111 was a very famous wheat field, and produced heavy crops of high quality wheat, it is now rather poor permanent pasture.

180—1 is taken from this formation in Kent, it is low in potash, but otherwise very similar to the others. It is a good productive soil, but the texture may easily be damaged.

180—2 is from the hop garden on the same farm, and is probably of different formation; it more nearly resembles a brick earth.

Other Soils.

Ref. No. 169. An old clover ley on the Thanet beds near Hoo, was examined.

Moisture	-	-	-	-	-	-	-	-	-	3.29
Loss on ignition	-	-	-	-	-	-	-	-	-	7.06
Nitrogen	-	-	-	-	-	-	-	-	-	.201
Calcium carbonate	-	-	-	-	-	-	-	-	-	1.84
Potash extracted by Hydrochloric Acid	-	-	-	-	-	-	-	-	-	.620
„ „ 1% Citric Acid	-	-	-	-	-	-	-	-	-	.0114
Phosphoric Acid extracted by Hydrochloric Acid	-	-	-	-	-	-	-	-	-	.192
„ „ 1% Citric Acid	-	-	-	-	-	-	-	-	-	.0630

Several Lincolnshire Clays have been sent in for Analysis.

	Ref. No.	19.	55.	164.	253.	740.	6.
Calcium Carbonate	-	.047	.105	.084	.064	.13	.07
Phosphoric Acid extracted by Hydrochloric Acid	-	.127	.094	.098	.104	.073	.099
Phosphoric Acid extracted by 1% Citric Acid	-	.0075	.0104	.0087	.0098	.0089	.0093
Potash extracted by Hydrochloric Acid	-					.135	.760
Potash extracted by 1% Citric Acid	-					.004	.2069

MANURING OF FRUITS.

A number of inquiries with regard to the manuring of fruit have been addressed to us, and the following notes are therefore given.

By far the most important experiments on this subject have been those carried out by Mr. S. U. Pickering, at the Duke of Bedford's Experimental Fruit Farm, Woburn.* The general method has been to compare the effects of moderate (12 tons) and heavy (30 tons) dressing of London dung, and of mixtures of potassium and magnesium sulphates, superphosphate, and sodium nitrate, containing the same amounts of the nutritive elements. The soil

* Reports of the Woburn Experimental Fruit Farm. Eyre and Spottiswoode, especially Fourth Report.

is not of the type usually selected for fruit growing, being of a stiffer nature.

Experiments have also been made by Messrs. Dyer & Schrivell, at Hadlow, Kent,* to ascertain whether light or heavy dressings of dung were best, and to what extent dung can be replaced by artificial manures.

At Wye an attempt is being made to discover the effect of omitting potash, nitrogen, and phosphoric acid from dressings of artificial manures.

Strawberries. Pickering finds that moderate dressings of dung or of artificials give a 12 to 15 per cent. increase in the crop. Dung improved the size and quality of the berries. Heavier dressings of dung had no effect whilst heavier dressings of artificials decreased the crop.

Dyer & Schrivell also find the 12 ton dressing of dung to be better than a heavier one, they claim that the addition of 4 to 6 cwts. of superphosphate and 2 cwts. of nitrate of soda hastens ripening, but Pickering could get no evidence of this.

Gooseberries. Pickering found that 12 tons of dung ultimately increased the crop, improving the size and quality of the berries, and the vitality of the plant. Heavier dressings were of no advantage.

Artificials alone, without dung, did not increase the crop, and in seven or eight years the plants died, giving out sooner than strawberry plants on neighbouring plots similarly treated.

It has also been observed at Wye that gooseberries will not survive on plots receiving no dung, although other fruits do well. Dyer & Schrivell also note that the use of artificials alone is not so satisfactory as when combined with dung. They state, too, that potash plays an important part in determining the yield.

Red Currants. Moderate dressings of dung and artificials increased the crop by 28 per cent. at Woburn and heavier dressings gave a still further increase. Moderate dressing of artificials also gave an increase of about 28 per cent., but as regards size and quality of the fruit, and the growth of the bushes, the plot was inferior to the dunged plots.

* *Journal of Royal Horticultural Society*, 1903, Vol. 27.

White Currants showed similar results.

Black Currants are so difficult to keep free from pests that no experiments with them have been successfully carried out. At Wye the general experience is that they do very well with artificial manures, but potash is essential ; in its absence the bushes are stunted, and the crop poor. The effect of withholding phosphoric acid or nitrogen is not marked. Dung produces better results than artificials.

Raspberries. The Woburn results are substantially the same as for red currants.

Apples. As a result of eight years experience at Woburn, Pickering has been unable to find that manuring has any effect on apple trees.

Speaking generally, we may say that moderate dressings of dung (about 12 tons) will give an increase in crop in all cases excepting apples, whilst heavier dressings will give little or no further increase. Dressings of artificial manures without dung give increased crops, except in case of apples and gooseberries, but in no instance is the size or quality of the fruit as good as when dung is applied. There is evidence to show that potash plays an important part in determining the growth and crop of currants, and perhaps of other fruits. At Wye potash was found to keep the plant growing in late autumn. On the other hand, no good evidence has yet been adduced in favour of the popular belief that iron or manganese salts improve the colour of the fruit.

It is not yet ascertained why dung should be so superior to the equivalent dressing of artificials. Pickering suggests its action on the soil as the explanation, and this is borne out by the well known susceptibility of fruit trees to differences in soil condition, a nice mellow soil being always considered most suitable for planting fruit.

There is no apparent reason why apple trees and gooseberry bushes should behave differently from the others. An apple tree forms a good deal of wood each year in addition to the fruit it bears, yet it appears to have no difficulty in getting unaided all the mineral and nitrogenous matter it wants from the soil. Gooseberries on the other hand, require some condition in the soil that is only secured by adding dung.

The amounts of plant food used during a season's growth by a mature tree in full bearing are not great. American experiments* show that the amount removed in the fruit from an acre of fruit trees averages about 16 lbs. of nitrogen, 7 lbs. of phosphoric acid, 3 lbs. of lime, 4.4 lbs. of magnesia, and 33 lbs. of potash. The total quantity in the leaves, new wood, and fruit is somewhat greater, but is less than that removed by an acre of wheat.

The difficulty of ascertaining the manurial requirements of ordinary farm crops is much accentuated when we turn to fruit crops. It is not possible to make a fresh start with fresh seed and new plants each year, the same plants have to be used continuously.

Owing to the amount of space each tree requires, a limited number only can be taken, and the individuality of the plant, which in experiments on cereal or root crops would be eliminated by the great number of plants in the plot, becomes an important factor. The trees do not bear fruit for some years after planting, and definite results cannot be looked for until observations have been made over a long period, during which, however, some of the trees, especially currant bushes, may have been attacked by disease and either killed outright, or cured by some drastic method that will leave its mark for years to come. Birds, too, are an invariable source of trouble.

The *raison d'être* of a fruit tree is to produce fruit, but fruit production is by no means a simple phenomenon. It is related to the general growth and well-being of the tree, but the two quantities are not proportional to one another, in fact, heavy bearing and heavy growth are usually antagonistic, and a slight check in growth will often increase the crop. The size of the fruit is a matter of importance to the practical man, as well as the total yield of fruit.

The effects of season and soil are so marked that it is almost impossible to ensure uniform results over a given plantation, and at the Woburn Farm the check plots show little or no agreement among themselves. Mr. Pickering got over the difficulty in some cases by plotting the results, and expressing them as a curve, but even this method did not always work. A killing frost in spring may not equally affect the whole garden, and any difference in

* Van Slyke, Taylor and Andrews, N.Y., Expt. Stn., Bull, 265, 1905.

ripening of the wood in autumn will show itself in the succeeding years. Not only does the season affect the tree, it also affects the insects on whose activity fertilisation of the flowers and subsequent value of the fruit depend. Again, pruning is always necessary, yet it is impossible to uniformly prune all the trees. Different varieties of the same fruit respond very differently to changes in conditions, and the results again vary according to the nature of the stocks.

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NOTES ON RECENT WORK.

By S. T. PARKINSON, B.Sc.

I. DAMAGE DONE TO FRUIT BY FROST.

It has long been known that orchards suffer a very considerable amount of damage from frosts in early spring. Methods for minimising this have been in use from very early times. Perhaps one of the oldest is the well-known method of lighting bonfires: this was even mentioned by Pliny about eighteen hundred and fifty years ago. He says, "The moon, however, is productive of no noxious effects at either of these periods, except when the nights are clear and every movement of the air is lulled; for so long as clouds prevail, or the wind is blowing, the night dews never fall. And then, besides, there are certain remedies to counteract these noxious influences. When you have reason to fear these influences, make bonfires in the fields and vineyards of cuttings or heaps of chaff, or else of the weeds that have been rooted up; the smoke will act as a good preservative."

It is curious how little the common idea has changed since his time. The moon is still regarded in many quarters as the cause of these frosts, though modern investigations lend no support to this view. This method of making bonfires has been developed by Lemstrom, in Finland, where early frosts do an enormous amount of harm to all crops. It is not necessary to go into detail about it here, since it is not generally practicable in England. Straw bonfires are generally too expensive and it would be bad practice on many grounds to allow weeds to accumulate to a sufficient extent to provide fuel; hedge clippings are also objectionable because of the danger of harbouring fungus diseases.

Enormous damage is done in California, where very valuable fruit crops are raised out of doors, and for many years a study has been made as to the best methods of preventing injury from the frosts.

Several methods have been found effective, either singly or in combination. Valuable fruit and garden crops are covered by oiled muslin or cheese cloth stretched on light wooden frames which extend over the whole crop. This has been found exceedingly effective for low growing crops.

Another method is to make bonfires of tar or oil, and in some cases these are made to run on moveable trucks through the plantations.

A third method is to spray water in the air when the mist formed reduces the loss of heat by radiation. This elegant method is said to be very effective, but it requires a strong pressure of water to produce the necessary spray.

A fourth method, and the one which is now being most generally applied, is the use of water. The water issues from the ground at a fairly high temperature and is allowed to flow through the orchard. The warm water raises the temperature of the air and then runs to waste. This method is obviously inapplicable in this country, where we have practically no warm springs.

It should be noted that all these methods have been found to work well in California, and the loss by frost is now very considerably reduced in that country. On careful consideration of them, however, it is evident that most of them could not be applied in England, and that the only one that seems at all promising is the smudge fire method.

This has already been tried in certain districts in this country, and a most practical and valuable article descriptive of it and written by Mr. Geoffrey F. Hooper appeared in the April number of the *Journal of the Board of Agriculture*.

The author, after calling attention to the very serious damage which is often caused by a few hours of frost in the early spring, proceeds to discuss methods for its prevention. Dismissing the older method of burning garden rubbish, straw, etc., as impracticable for a large acreage, on the ground of expense as well as possibility of damage to trees and bushes, he proceeds to give details of

“smudging” experiments carried out by Mr. C. Martin on the Toddington Orchard Company’s plantations near Winchcombe, and by himself on his own fruit farm at Pershore.

Trials of numerous fuels resulted in the adoption of a mixture of creosote with naphthalene and a little water. This was burnt in a cast iron vessel, which was also specially designed as the outcome of many experiments and has the advantage of keeping the flame well under control and preventing too rapid combustion.

In the actual experiments forty of these pots, each holding a gallon of the fuel, are used per acre. An electric thermometer sounds an alarm when the temperature falls below freezing point and the lighting of the pots is immediately proceeded with.

The burning creosote causes a dense pall or “blanket” of black smoke, which hangs at a height of a few feet from the ground.

The author gives a full account of an actual “smudging” and after discussing the financial aspect of the question, describes the results as “very gratifying.” The trial at Toddington was estimated as saving at least £150 worth of fruit and that at Pershore £75, the entire cost of the experiment in the latter case being within £12.

The “smudge” may produce several distinct effects. There may be an actual rise of temperature, though this does not seem to be definitely established; the cloud certainly reduces loss of heat by radiation. This may act in two ways, it can prevent the fall of temperature in the night and the sudden rise of temperature in the morning.

These spring frosts occur most frequently on still, clear nights, but they also occur under other conditions; in fact the phenomena are very complex.

Moreover, there are other factors to be taken into consideration. The duration of the frost, its intensity, the rapidity of thawing, the amount of moisture on the trees, may all influence the final result.

Experiments have been carried out at this College during the present season, both on the best methods of smudging and on the general phenomena of late frosts.

Various mixtures of paraffin, creosote, and naphthalene were tested to try and find a good smudging oil. The points noted were

the heaviness and quantity of smoke given and the time the mixture burnt. Of the various mixtures tried, the best appeared to be either creosote, or a mixture of $\frac{2}{3}$ creosote and $\frac{1}{3}$ naphthalene by weight. Paraffin mixtures burnt too quickly and gave a lighter smoke.

A few preliminary tests were also made with coke fires. These, as arranged for our experiments, did not appear to burn sufficiently brightly on still nights, but with a slight wind they gave more promise of being useful. Owing to the small number of spring frosts this year it was not possible to make sufficient tests to draw any definite conclusion.

It is obviously desirable to have an accurate knowledge of all available facts with regard to the action of frost and the actual changes of temperature that occur, and investigations and collection of information on the following points are in hand.

1. The changes of temperature that occur in plantations between sunrise and sunset.
2. The distribution of temperature near the ground and at the height of the blossoms.
3. The effect of antecedent weather conditions.
4. The effect of local conditions (shelter, shade, air currents, situation, etc.)
5. The incidence of frost in variously arranged plantations; such questions for example as whether more damage is done in plantations wholly of gooseberries or where these are mixed with plums.
6. Whether the nature of the ground and methods of cultivation have any effect on hindering frost damage.
7. The examination, microscopical and otherwise, of the injuries actually done by the frost.
8. The effect of artificial freezing on blossoms.

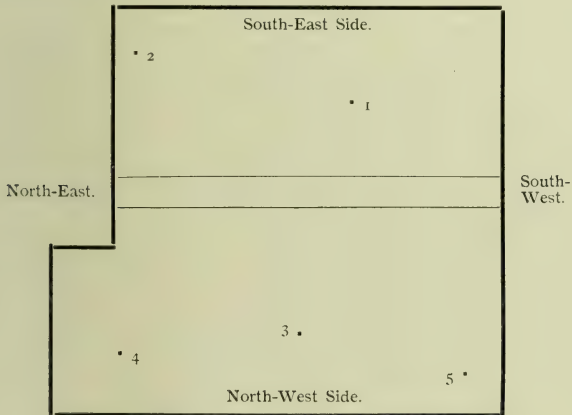
DISTRIBUTION OF TEMPERATURE.

The temperatures, which are officially recorded in this country, as for instance at Kew, are screen temperatures taken four feet above the ground and minimum temperatures, taken on the grass. These are hardly what we require, as to mention one factor only, fruit trees are usually out in the open and do not correspond to the position of the thermometers in the screen.

In order to collect information with regard to the conditions which actually occur, five stations were selected in the College experimental plantation. At each station a post was fixed on the ground and two Centigrade thermometers attached to it, one *just above* the surface of the ground, and the other at a height of 5ft. 6in. The thermometers were checked against a standard thermometer with a Kew certificate.

The plantation is on a slope at the base of the Downs and about 200 ft. above the sea level. It stands about midway between the Downs, which rise to a height of 670 ft. above, and a river in the valley below, which is 95 ft. above sea level.

Further particulars are as follows :—



Station I.—Very exposed and open, especially on the South and East. Very young bush apples, gooseberries, etc.

II.—Exposed situation. Standard plums and apples; raspberries and black currants, closely planted on ground.

III.—Sheltered. Cherries and bush apples, 10 ft. apart. Apples about 8 ft. high, cherries taller. Black currants on the ground near.

IV.—Sheltered. Apples 10 ft. apart, gooseberries between.

V.—Very sheltered. Closely planted bush plums, about 12 ft. high.

Readings were taken through the night, at intervals of two hours. The actual figures are reproduced with notes in the tables on pp. 255 and 256.

There is no evidence in these figures that the trees afford any protection to bushes growing between them, it will be seen that on some nights the temperature in the sheltered part is actually lower than that in the exposed part. Without committing ourselves to any definite explanation of this fact we may state that it is quite consistent with the trees having a lower temperature than the surrounding air as a result of the unchecked radiation.

Throughout the night the temperature at the height of 5 ft. is higher than that of the ground, but about sunrise there is usually a reversal and the ground temperature becomes higher than that 5 ft. up.

Another series of readings was taken to discover if the condition of the ground (whether arable or grass) had any considerable effect on a liability to frost.

Through the kindness of Mr. Robert Amos these readings were taken at Perry Court, Wye. They are set out in the first of the tables on page 257, and were taken on minimum thermometers, two of which, A and D, were in grass plantations, and another two, B and C in adjacent plantations which were under cultivation.

Position of thermometers :—

Series 1 :

- A. In apple orchard (fairly big trees) ; grass underneath.
- B. In plantation (apple, plum, pear) ; gooseberries thick underneath.

Series 2 :

- C. In plantation (apple, plum) ; gooseberries and currants in tree-rows. Open between rows of trees.
- D. In apple orchard (small trees), grass underneath.

A and B are about fifty yards apart ; as far as can be seen the exposure is similar. C and D are also about fifty yards apart, but about a quarter mile from A and B. They lie a little lower down the slope.

Selecting only the frosty nights, which are of main importance, from our present point of view, we obtain the results shown in the second table on p. 257.

TEMPERATURE DURING NIGHT IN FRUIT PLANTATION, WYE,

DEGREES CENTIGRADE.

RECORDED BY S. T. PARKINSON AND R. S. VINSON.

Date.	6ft. from Ground.						6ins. from Ground.						Remarks.	
	No.	10 p.m.	12 p.m.	2 a.m.	4 a.m.	6 a.m.	8 a.m.	10 p.m.	12 p.m.	2 a.m.	4 a.m.	6 a.m.		8 a.m.
Ap. 9-10	2	2.4	1.2	1.8	3.0	3.7	5.6	1.6	.9	+ .4	2.3	3.4	6.1	Stars out, but misty and wet in valley. No wind. A slight breeze sprang up about 4 a.m., and the mist cleared from valley but hung round hills.
	1	2.8	1.1	2.0	2.8	3.8	5.8	1.3	— .1	+ .4	2.2	3.3	6.4	
	5	2.8	.5	2.3	2.8	3.8	6.0	1.8	— .1	+ .1	2.0	3.5	6.4	
	3	2.4	1.5	2.3	2.7	4.0	5.8	1.9	— .2	+ .6	1.7	3.6	6.0	
	4	3.0	.4	.7	2.5	3.9	5.6	2.6	.9	— .2	1.3	3.7	6.4	
Ap. 10-11	2	+ .8	— .4	+3.6	4.3	4.4	4.5	+ .3	— .4	3.3	3.7	4.3	4.5	Started misty, with stars just out, no wind. Was clearer at 12 p.m., but by 2 a.m. had clouded all over and remained misty till morning.
	1	+ .5	— .1	+3.5	4.2	4.4	4.5	— .4	—1.2	2.8	3.7	4.3	4.6	
	5	+ .3	— .8	+3.5	4.2	4.3	4.7	+ .2	— .8	2.8	3.8	4.3	4.6	
	3	+ .4	—1.0	+3.7	4.3	4.3	4.7	+ .3	— .8	3.1	3.7	4.2	4.6	
	4	+ .5	— .8	+3.7	4.2	4.3	4.8	+ .2	— .8	3.2	3.6	4.3	4.9	
Ap. 13-14	2	5.9	4.3	5.4	5.7	6.35	7.4	5.0	4.2	5.4	5.6	6.3	7.8	Trees started dry, but at 12 p.m. a dense mist came up and wet everything. A slight breeze varying from E.N.E. to N.N.E. About 6 a.m. the fog lifted a little and the trees were dry by 8 a.m.
	1	6.1	4.4	5.6	5.8	6.4	7.4	5.2	4.2	5.4	5.6	6.35	7.8	
	5	5.9	4.3	5.5	5.6	6.25	7.3	5.4	4.2	5.5	5.6	6.2	7.7	
	3	5.7	4.3	5.5	5.7	6.3	7.4	4.9	4.1	5.4	5.6	—	—	
	4	5.7	4.3	5.7	5.7	6.2	7.2	5.0	4.3	5.4	5.7	6.3	7.9	
Ap. 15 16	2	4.3	6.2	5.5	5.3	5.1	5.2	3.7	5.8	5.4	5.2	5.2	5.4	Started clear and starry, with slight N. breeze. By 12 p.m. it was very dark and cloudy with a slight mist, wind N.N.E. Trees were dry all night.
	1	4.4	6.3	5.5	5.3	5.2	5.2	3.7	5.8	5.4	5.2	5.3	5.3	
	5	4.4	6.2	5.5	5.3	5.1	5.2	3.8	5.8	5.3	5.2	5.2	5.3	
	3	4.4	6.3	5.5	5.3	5.1	5.2	3.9	5.9	5.4	5.4	5.3	5.4	
	4	4.4	6.3	5.3	5.3	5.1	5.2	3.8	5.8	5.2	5.4	5.4	5.6	
Ap. 16-17	2	6.5	5.3	4.0	4.5	3.4	4.8	5.9	4.7	3.5	4.4	3.6	6.1	Started rather cloudy with but few stars and a N.E. wind. At 12 p.m. it was clear and starlight, and wind dropped. At 2 a.m. it began to get thicker and by 4 a.m. was cloudy with a freshening N. wind, strong by morning.
	1	6.5	5.2	4.0	4.5	3.4	5.4	6.0	4.4	3.5	4.4	3.6	6.6	
	5	6.3	5.1	4.1	4.6	3.3	5.3	5.8	4.3	3.6	4.4	3.4	5.2	
	3	6.5	5.0	4.1	4.6	3.3	5.0	6.2	4.5	3.7	4.5	3.5	5.9	
	4	6.4	4.9	4.1	4.5	3.4	5.2	5.8	3.9	3.6	4.4	3.7	6.8	

		6 ft. from ground.						6 ins. from ground.							
Date.	No.	10 a.m.	12 p.m.	2 a.m.	4 a.m.	6 a.m.	8 a.m.	10 p.m.	12 p.m.	2 a.m.	4 a.m.	6 a.m.	8 a.m.	Remarks.	
Ap.18-19	2	1' 1	-1' 7	-2' 2	-2' 5	.8	5' 4	.7	-1' 7	-2' 2	-2' 0	.5	5' 4	Starlight night, high clouds slowly moving from N., no wind, by 2 a.m., there was frost on leaves which were stiff, but not brittle; at 6 a.m. the sun came out and leaves became wet and by 8 a.m. they were all dry and a slight NW. breeze sprang up.	
	1	.4	-2' 2	-2' 7	-2' 7	.5	4' 9	—	-2' 7	-2' 3	-2' 5	0' 0	5' 4		
	5	.6	-1' 9	-3' 0	-3' 0	—	6' 1	.1	-1' 9	-2' 3	-2' 0	—	6' 1		
	3	—	-2' 7	-3' 0	-3' 3	.1	5' 4	.2	-2' 5	-2' 6	-2' 0	.3	5' 9		
	4	—	-2' 5	-1' 7	-2' 7	.2	5' 5	.2	-2' 3	-2' 4	-2' 1	0' 0	5' 8		
Ap.19-20	2	—	-2' 3	-3' 5	-3' 5	—	5' 9	-1' 1	-2' 2	-3' 0	-2' 6	-1' 0	5' 1	Clear and starlight, no wind, trees dry, by 12 p.m. leaves were glistening and everything was covered with hoar frost by 2 a.m.; by 4 a.m. leaves were curled and drooping and frozen stiff and crisp. Bright sun at 6 a.m. and thawing. S. breeze.	
	1	-1' 8	-2' 9	-4' 0	-3' 5	—	5' 5	-2' 2	-3' 0	-4' 0	-3' 5	-1' 3	5' 1		
	5	-1' 2	-2' 3	-3' 8	-3' 6	.95	5' 4	-1' 4	-2' 4	-2' 8	-2' 5	—	5' 5		
	3	—	-2' 8	-4' 0	-4' 0	-1' 1	5' 5	-1' 4	-2' 5	-2' 8	-3' 0	—	5' 3		
	4	-1' 0	-2' 7	-3' 6	-3' 7	—	5' 8	-1' 3	-2' 3	-3' 2	-3' 0	.7	5' 6		
Ap.20-21	2	6' 8	7' 7	7' 4	6' 8	7' 0		5' 8	6' 4	6' 1	6' 2	7' 0		Thick and dark, no stars, strong breeze from W. Leaves and trees dry. Turned to a wet misty day by 8 a.m.	
	1	7' 2	7' 8	7' 4	6' 9	7' 0		6' 4	7' 0	6' 3	6' 3	6' 8			
	5	6' 8	7' 5	7' 3	6' 8	6' 9		6' 1	6' 5	6' 7	6' 4	7' 2			
	3	7' 0	7' 7	7' 4	6' 7	6' 9		6' 3	6' 8	6' 8	6' 4	6' 8			
Ap.22-23	4	6' 8	7' 7	7' 4	6' 8	7' 3		6' 2	6' 8	6' 5	6' 1	7' 1			
	2	6' 2	6' 8	5' 8	5' 0	6' 1	9' 7	5' 1	5' 1	4' 2	3' 9	5' 5	9' 6	Clear bright moonlight night with a few high clouds about. Slight breeze E.S.E. freshened towards morning. Sun not bright at 8 a.m.	
	1	6' 1	6' 6	5' 6	4' 9	6' 2	9' 9	5' 1	5' 2	4' 6	4' 1	5' 7	10' 0		
	5	5' 7	5' 5	5' 2	4' 6	6' 1	9' 5	5' 4	4' 6	4' 2	3' 8	5' 7	9' 6		
3	6' 1	5' 5	5' 4	4' 8	6' 3	9' 8	5' 2	4' 8	4' 6	4' 0	6' 0	10' 0			
	4	5' 65	5' 5	5' 4	4' 8	6' 8	9' 9	5' 2	4' 5	4' 5	4' 2	6' 1	10' 1		

MINIMUM NIGHT TEMPERATURES AT PERRY COURT.

DEGREES FAHRENHEIT.

COMPILED AND RECORDED BY MR. R. S. VINSON.

Date.	6 ft. Grass.		6 ft. Arable.		6 in. Grass.		6 in. Arable.		Remarks.
	A.	D.	B.	C.	A.	D.	B.	C.	
Ap. 16		37.5	38	38	39		38	37.7	Ground dry.
17		36.7	37	37.7	36.7	35	36.5	37.5	Fine, very cold, N. wind.
18 28		31.7	30.5	31	30	28		30.5	Fine, very cold, N. wind, frost slight.
19 22		23	24	24	26	21	25.5	25.7	Clear night, no wind, frost sharp.
20 22.7	21	22	22		23.5	18.5	23.5	24	Clear night, no wind, frost sharp.
21 35.5		38.5	38.5		38	34.5	38	38	Warm misty night. South wind.
22 38.5	42.5	42	42		41.5	38	40	41	Warm night, after wet day.
23 35	34.5	34	35		35.5	34.5	34	35.5	Moonlight, but thick.
24 47	47	47.5	48		48	47	46	46.5	Bright half moon, wind S., slight.
25 40	42	41.5	41.5		41	40	40	40	Moonlight, but cloudy.
26 39.7	40	40	40		41	40	39.7	40	Wet, misty night and day.
27 30.5	31.5	31	30.5		32.5	31	30.5	31	Rain in night, cleared early morning.
28 30	32.5	32	32		31.5	31.5	30.5	32	Rain in night, wind N., moderate.
29	38	38	38		38.5	36.5	37	38	Rain in night, then cleared, wind N. slight.
30 30	32	31.5	32		32	30	30	31	Fine night, no wind, followed by wet day
May 2	32.5	34	34.5	33.5	33	31.5	33	33	Started clear night, then rained, wind S.W., strong.
3 40	41	40.5	40.5		40	39.5	37.5	38.5	Wet night, wind S.W., slight.
4 40	41.5	41.5	41.5		40.5	40		40	Rough night, with rain.
5	36.5	36.5	36.5		36	34.5	34.5	35.5	Calm night, clear till 11 p.m., then cloudy.
6 42	42	42.5	42		42		40	40	Dull night, S. wind, very slight.
7	46.5	47.5	47		47.5	47	46	46	Dark showery night.
8 40	40	40	40		40	37.5	38.5	39	Clear starlight night, wind S.W. v. slight.
9	37	38	37		38	35	36	35.5	Dull, wind S., moderate.
10 46		46.5	45		44.5	44	44	44	Clear night, wind S.
11	48	48.5	47		46.5	46	45.5	45.5	Clear night, clouds about, wind S.
17 41	41.5	42	41.5		42	41	41.5		Dull dark night, no dew, no wind.
18 34.5	35.5	35.5	35.5		34.5	35	34.5		Clear night, cold N. wind, moderate.
19 32.5	34	34	34		32.5	34	33.5		Clear night, clouds about, cold N. wind.
20 32.5	33.5	33.5	34		34	33	34	35	Clear night, showers early morning, N. w.
21 29.5	30	30	30		31	32	32	32.5	Clear night, frost 1.30 to 2.30 a.m., no w.
22 47	47.5	48	48		46	46	47	47.5	Wind S., much warmer, dull.

Date.	6 ins. from ground.				6 ft. from ground.				Remarks.
	A.	D.	B.	C.	A.	D.	B.	C.	
Ap. 18	30	28		30.5	28	31.7	30.5	31	Cold N. wind, frost slight.
19 26		21	25.5	25.7	22	23	24	24	Fine night, clear morning.
20 23.5	18.5	23.5	24		22.7	21	22	22	Clear night, no wind, frost sharp.
28 31.5	31.5	30.5	32		30	32.5	32	32	Rain early in night, cleared later.
30 32	30	30	31		30	32	31.5	32	Clear, moon rather hazy, no wind.
May 21 31	32	32	32.5		29.5	30	30	30	Clear night, no wind, frost only lasted about 1 to 2 hours.
Mean									
Temp. 29	26.8	28.3	29.3		32	28.4	28.3	28.5	

Result. A. (on grass) slightly warmer than B. (on arable).

D (on grass) slightly colder than C. (on arable).

As far as this series of experiments shows, the condition of the ground whether cultivated or grass would seem to have little to do with liability to frost.

Another series of readings was taken down the slope from the top of the Downs to the river. Although these have not yet been fully analysed they show that the lower levels are much more liable to frost than the higher ones.

In these thermometer readings we have had the assistance of Mr. R. S. Vinson, to whom our best thanks are due for the painstaking manner in which he has carried out, not only this work, but other experiments on this subject. These observations are of course only to be regarded as preliminary. They are not sufficiently extensive to enable us to draw very general deductions, and it is proposed to extend them next year.

ARTIFICIAL FREEZING.

The effect of artificial frost was tried on forty-five different twigs of four sorts of trees, viz. : morello cherries, damsons, greengages and apples.

In order, as far as possible, to obtain natural conditions, the freezing was carried on with living twigs actually on the tree. By thus keeping the twig on the tree it is possible to watch its further growth and to compare it with others, which have not been treated.

The part of the twig to be frozen was put into a freezing chamber and surrounded by another vessel containing a mixture of ice and salt.

A sensitive Centigrade thermometer was fixed so that the bulb was in the freezing chamber, and readings were taken every two minutes. The end was covered in so as to inclose the twig as completely as possible and precautions were taken to prevent the flowers and leaves from touching the cold sides of the freezing chamber.

We have so far tried the effect of (1) varying temperatures for the same interval of time, and of (2) the same temperatures for varying intervals of time.

Short exposures to frost, even if the temperature falls as low as -6°C . seem to have but little effect on apple and damson blossom; this is in accordance with the general experience that apple and damson blossoms suffer less from frost than, for instance, greengages and cherries.

This is well seen in the following cases :—

	Minimum No. degrees (Centigrade) below zero.	Time of freezing (in minutes).	
Apple	8.8	14	Flowers and leaves killed, but dormant buds breaking.
	7.4	14	Flowers all killed, early leaves affected, but shoot quite recovered.
	6.3	40	Flowers all fallen, leafage rather worse than last.
	3.0	66	One fruit set, but retarded. Foliage unaffected.
Damson	6.3	12	Unaffected.
	6.2	20	All flowers killed and leaf buds received a big check.
	3.9	20	Unaffected.
Cherry	4.0 (in bud)	30	Unaffected.
	4.5	10	Killed.
	2.6	10	Many fruits set.
Damson	6.5	11	Unaffected.
Cherry	6.4	10	All blossoms killed.
Apple	6.9	9	Unaffected.
Cherry	4.5	10	Killed.
Apple	4.9	30	Unaffected.

Experiments on the cherries were very much disturbed by the subsequent appearance of the fungus disease, known as Brown Rot, which affected or even killed several of the selected twigs, although they had shown no signs of disease at the time of freezing. The shrivelling up of the trusses caused by this disease is very frequently put down to frost.

On opening some apparently healthy flower buds, before freezing the twig, the centres in many cases were found to be turning black, another symptom often attributed to frost, but in this case not due to this cause, as we had experienced no frost for some time previously and the tissues on examination proved to be full of

fungus threads. Although this interfered with the experiment, it was interesting to notice how easily wrong conclusions might be drawn concerning the matter. In addition to the above a number of preliminary observations were made with regard to the effect of artificial freezing on strawberry plants growing in pots.

Our hearty thanks are due to Mr. Crompton for valuable assistance in all these freezing experiments.

II. CAKES AND FEEDING STUFFS.

During the past year we have had to report on the purity of various samples of seed mixtures and foodstuffs.

In this country it is now customary to make a chemical examination of cakes, meals and other feeding stuffs. By means of such a test the amounts of oil, nitrogen and fibre present are estimated and the feeding value determined. In addition to this the quantity of ash and sand present is found. This information with regard to the chemical substances present and the proportions in which they occur, is of the greatest importance in drawing deductions as to the state of purity of the sample and also its value as a food; but besides this purely chemical method, recourse is often made to a supplementary botanical or microscopic examination, for by this means we can often discover the actual names of the substances used in the composition of the food. For example, as the result of chemical analysis a sample of linseed cake may be found to be abnormal in composition, the microscope is now brought to bear on the matter and we can at once tell whether there has been adulteration or not. Seeds and starches especially are often quite easy to determine by this method.

Both methods are in daily use, and both are valuable; often the botanical method is as useful as the chemical, and especially so when the object of the examination is to discover the special adulterants in suspected cakes and meals.

About a quarter of a century ago, the Association of German Millers offered a prize for an essay indicating a practical method for detecting impurities in flour. The winning essay advocated a microscopical, *i.e.*, botanical examination.

Since then the subject has received much attention, and a considerable technical literature has sprung up, especially in Germany and in France. In England, though, as previously stated, we generally invoke the aid of the microscope, this branch of applied botany cannot boast of having come much to the front, at any rate in respect to its relations with agriculture. English books on the subject are few, and devoted rather to the requirements of the general food analyst than to the special needs of the agricultural botanist.

In America the subject is receiving attention, and last year, Mr. A. L. Winter, the director of the Connecticut Experimental Station, and Professor Dr. Joseph Moeller, head of the Pharmacological Institute of the University of Gratz, published a clearly-written and well illustrated book on the microscopy of vegetable foods. The authors deal with all manner of vegetable foods, but an effort is made to give prominence to the requirements of agriculturists.

Last summer the writer spent a portion of the summer vacation at this town of Gratz, which is situated in a mountainous district of the Hungarian province of Steiermark, of which it is the capital. The town only possesses about 150,000 inhabitants, but there are, what, to our English minds, would be considered a really extreme number of imposing and costly educational institutions, and there is no doubt, from the money lavished in these buildings and the pride the inhabitants take in them, that the people are alive to the importance of education as a factor in modern life.

Through the generous courtesy of Professor Moeller, opportunity was given of daily work in the University laboratory, and for studying the processes employed, the methods of work, and the very large collections of food, food materials and prepared specimens in the institution.

From the results obtained in other countries there is no doubt that the methods of botanical analysis might be more fully and generally employed in this country than is at present the case.

A considerable number of useful specimens and microscopic preparations of the botanical constituents of cakes and feeding stuffs have now been added to the material already available for this work in the College laboratory, in the hope that we shall be able to extend the usefulness of the department in the direction indicated.

III. CHICK FOOD.

A sample of "dry chick food" was sent in for examination. The object of the inquiry was merely to ascertain if it was wholesome and nourishing for young chicks, which it was suggested should be reared entirely on it.

The sample contained tail wheat, some lentils, canary grass, millet, maize meal and fragments of rice, mixed with a considerable amount of dirt and weed seeds. The latter, together with the tail wheat, indicated that the sweepings from some threshing machine had been freely utilised in the composition of the food.

Amongst more than a dozen different kinds of weed seeds, those of corn cockle predominated. Without discussing the merits of the food for chicken rearing we would strongly advocate the employment of a food free from so much impurity. This dry food is fed without any sort of preparation, such for instance as grinding or cooking, that might destroy the vitality of the seeds.

Further, in order to secure an adequate amount of exercise for the birds when in the close confinement of, say, a foster-mother, it is scattered among the chaff or some other loose material on the floor of the coop.

To ensure cleanliness the chaff is constantly cleaned out from the coop and may very easily, without any rotting, be scattered on land adjacent to the fowlhouse. It is but reasonable to suppose that this chaff will contain many of the small weed-seeds that have been overlooked by the birds and in this way become a means of distributing them on the land. There is the further possibility that the gizzard of such small chickens may allow some of the small and harder seeds to pass through the alimentary tract unharmed, in which case the dung itself becomes a means of carrying them to the land.

Weeds are already numerous enough on the land, but if our deductions are valid, we feel that we cannot too emphatically warn farmers that such a dry chick food as we have described *may* not only add to the quantity of weeds, all too many as they are, but may further, *by introducing new varieties into a district*, increase the difficulties of keeping the land clean.

We have said nothing as to whether the weed seeds themselves are or are not a wholesome food, but by comparing the food in question with other samples on the market, we are convinced that the price asked (some £12 per ton) was enough to secure high feeding material having no disadvantage such as we have described. If such impurities as we have described are really a necessary addition to the food, doubtless many farmers would be glad to find a useful outlet for their own "sweepings," rather than pay a high price for similar material elsewhere. Anyhow, we recommend a careful examination of any "dry" food before feeding it in such a way as might lead to weed distribution.

For the information of poultry keepers we would add that the following are the materials usually employed in dry chick food: tail wheat, lentils, oatmeal grits, fragments of boiling peas, broken maize and broken rice. There is no difficulty in recognising these, for none of them are in any way seed-like in appearance. Canary seed, Dari, millet, are legitimate seeds. Samples of these may be obtained from any corn-chandler, they should be examined and compared with the seeds in the food, and if any other seeds are found in the latter, it should be subjected to careful examination before use. With the exception of charlock seed any weed seeds are not likely to be present in anything like bulk, so that the presence of only two or three, or of isolated seeds of many different kinds may be looked upon as indicating something in the nature of an impurity.

Besides the above materials, which may strictly be described as "food," small particles of stone, known to poultry keepers as "grit," together with minute pieces of oyster or other shell are often included. These need cause no anxiety, but since they may be purchased at comparatively cheap rates, it might be advisable to obtain these "aids to digestion" separately, for there is no merit in feeding them mixed with and at the price of expensive food.

REPORT ON ECONOMIC MYCOLOGY

FOR THE
YEAR ENDING APRIL 1ST, 1907.

BY
ERNEST S. SALMON, F.L.S., Hon. F.R.H.S.

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INTRODUCTORY NOTE.

During the past year ending April 1st, 1907, a large number of communications concerning subjects connected with Economic Mycology have been received. The greater number of specimens and communications sent by growers had reference to the following diseases: Apple Scab or "Black Spot" (*Fusicladium dendriticum*), Pear Scab (*F. pirinum*), Brown Rot (*Sclerotinia fructigena*), Powdery Mildew of the Apple (*Podosphaera leucotricha*), and "Canker" (*Nectria ditissima*).

A large number of inquiries with respect to spraying and other remedial measures against the above pests have been received.

Among other fungus diseases sent were examples of *Eutypella Prunastri* (which in one case had suddenly attacked and killed twenty per cent. of the trees in a young plantation of "Victoria" Plums), the *Botrytis* disease of the Gooseberry, the Pear Leaf Cluster-cups (*Gymnosporangium Sabinæ*), *Exoascus* of the Cherry, "Bitter Rot" of Apples (*Gloeosporium fructigenum*), Cherry Leaf Scorch (*Gnomonia erythrostoma*), Tree Root Rot (*Armillaria mellea*), *Sclerotinia Trifoliorum* (associated with or causing "clover sickness"), Strawberry "mould" or mildew (*Sphaerotheca Humuli*), the "Silver Leaf" disease of Plums, Peach Leaf-curl (*Exoascus deformans*), Lettuce Mildew (*Bremia Lactucae*), Tomato Leaf Blight (*Cladosporium fulvum*), Larch Disease (*Peziza willkommii*), Onion Mildew (*Peronospora Schleideni*), a "shot-hole" disease of Plums, Damsons, and Cherries, a "scab" disease of Potatoes, the *Rhizoctonia* disease of Sea-Kale, Carrot, etc., Plum Leaf Rust (*Puccinia pruni*), Clover Leaf Spot (*Pseudopeziza trifolii*), Dry Rot (*Merulius lacrymans*), and a "Soft Rot" of stored Apples (*Penicillium*).

The more important of these diseases will be dealt with in future numbers of the Journal.

As regards Kent, the fungus diseases which at the present time are most widespread and causing the greatest loss to fruit-growers are, Apple Scab or "Black Spot" (*Fusicladium dendriticum*, Fckl.), and "Brown Rot" (*Sclerotinia fructigena* Pers.); also Apple Powdery Mildew (*Podosphaera leucotricha* (Ellis and Everhart) Salmon), and Cherry Leaf Scorch (*Gnomonia erythrostoma* (Pers.) Auersw).

Demonstration spraying experiments against "Brown Rot" and "Cherry Leaf Scorch" were carried out during last season, and are recorded below. As far as arrangements permit, spraying experiments against these or other fungus diseases will be conducted on any farm on application from fruit-growers residing in Kent or Surrey.

Apple Scab or "Black Spot," concerning which a very large number of inquiries have been received, is now so prevalent in the orchards and plantations of Kent and Surrey that it is quite clear that if growers wish to avoid the very considerable loss now being caused by the presence of "scabby" apples they must adopt a course of systematic spraying against the disease. As pointed out below (p. 295), healthy trees and clean fruit can be grown if the leaves are sprayed with Bordeaux mixture in spring and summer, and the young wood (in those cases where the fungus has attacked it) with a solution of copper sulphate in winter.

In connection with this disease visits have been paid to various parts of the county for the purpose of giving practical demonstration of the mixing and application of Bordeaux mixture; and, so far as arrangements permit, I shall be pleased, on being applied to, to visit any fruit-grower in the counties for this purpose.

The extensive damage done to the apple crop and trees by this "Black Spot" fungus is now beginning to be realised by growers. I propose, if possible, to make a circuit of Kent this year at the time when the apple crop is being gathered, with the object of ascertaining what proportion of the crop is affected by this fungus disease, and also to what extent the young wood of the trees is attacked. I hope for the co-operation of fruit-growers in this matter, and shall be glad to hear from any grower a week or so before the gathering of his main crop of apples, with a view to paying a visit at that time.

During the past year the American Gooseberry-mildew (*Sphaerotheca mors-uvae* (Schwein.) Berk.), has been discovered in England,

having being introduced on imported gooseberry-stock. This fungus, which during the past few years has found its way from America into Europe, is the most destructive pest known of the cultivated gooseberry, and practically prevents the commercial cultivation of the European Gooseberry in America. If this mildew is allowed to establish itself in this country it may be expected that it will spread as quickly through gooseberry plantations, and cause as much destruction as the closely allied hop "mould" does in hop-gardens. A fully-illustrated description of the American Gooseberry-mildew is given below.

A considerable amount of time and labour has had to be expended in order to induce the Board of Agriculture to pay serious attention to this new pest of gooseberries, which is just being imported into this country. More is said on this matter in the following pages (see p. 299). With the help of the National Fruit-growers' Federation, a Bill to deal with the matter has at length been obtained from the Government. This Bill ("The Destructive Insects and Pests Act, 1907") is now before Parliament, and if passed, will constitute the first legislative measure against fungus diseases put into force in this country.

It must be pointed out, however, that gooseberry-growers are still threatened with imminent danger from the spread of this disease, since the Bill is not likely to be in force for some months, while, as pointed out below (see p. 276), the mildew will be spreading by its spores throughout the summer months; further, the gooseberry-plantations in Worcestershire and Gloucestershire already known to be infected (some thirty in number) are not all being dealt with in a sufficiently thorough manner to ensure the stamping out of such an infectious disease as this is known to be.

A large number of specimens of gooseberry-twigs suspected of being attacked by the American Gooseberry-mildew have been received during the past months; in most cases the injury proved to be due to a severe attack of "green fly" (*Aphis*); in several cases, however, where the examples came from Worcestershire, the presence of the mildew was confirmed, and the advice given to grub up and burn the affected bushes. Dead (poisoned) examples of the mildew have been sent out to aid growers in detecting it on the shoots in winter.

Finally, I would call attention to a matter of the greatest importance to fruit-growers. It will be remembered that the first—and perhaps the most important—recommendation made by the Departmental Committee, appointed by Lord Onslow in 1905, to inquire into the condition of the fruit industry of this country, was to the effect that “a special sub-Department of the Board of Agriculture and Fisheries be established to deal with matters connected with the fruit industry.”

I wish to take this opportunity of calling the earnest attention of fruit growers to the fact that nothing has been done in the direction indicated, and of impressing upon them the necessity of uniting to secure this necessary reform.

There was never a greater need for the existence of such a sub-Department than at the present time, when it is becoming absolutely imperative for British fruit-growers to grow clean fruit and healthy trees if they wish to compete successfully with other countries. We require a Department supplied with the requisite scientific knowledge and prepared to act at once to safeguard growers against fungus and insect pests. It must, I think, be the opinion of all those who have been endeavouring for the past months to get the authorities to pay prompt and serious attention to the new fungus disease (American Gooseberry-mildew) which may threaten the cultivation of the gooseberry in this country, that the interests of fruit-growers will never receive adequate attention until such a sub-Department exists at the Board of Agriculture and Fisheries.

I wish to express my thanks to the following gentlemen for kindly giving me scientific information in connection with various plant-diseases:—Prof. B. T. Galloway, Chief of the Bureau of Plant Industry, Department of Agriculture, U.S.A.; Prof. S. A. Beach, of the Iowa State Agricultural College, U.S.A.; Prof. J. Eriksson, Director of the Experimental Station, Stockholm; the late Prof. E. Rostrup, of Copenhagen; the late Prof. R. Aderhold, Director of the Royal Agricultural Institute, Berlin; Prof. F. Elfving, of the University Botanical Institute, Helsingfors; Dr. W. Herter, of the Kaiser Wilhelm Agricultural Institute, Bromberg; Prof. A. de Jacewski, of the Imperial Botanic Gardens, St. Petersburg; Prof. W. A. Orton, of the Bureau of Plant Industry, Depart-

ment of Agriculture, U.S.A. ; Prof. J. Ritzema Bos, of Amsterdam ; Prof. P. Magnus, of Berlin ; Prof. T. Johnson, of the Royal College of Science, Dublin ; Mr. F. W. Moore, of the Glasnevin Botanical Gardens ; Prof. M. C. Potter, of the Armstrong College, Newcastle ; Mr. V. H. Blackman (late of the British Museum, Natural History), and Mr. A. D. Cotton, of the Herbarium, Royal Botanic Gardens, Kew.

I am very greatly indebted to Mr. W. H. Hammond, of Canterbury, for invaluable assistance in supplying me with a number of photographs.



C. M. Beard, del.

Bale and Danielsson, Ltd.

Plate 1

Figs. 1, 2, 4.—Tips of shoots attacked by the American Gooseberry mildew.

Fig. 3.—Tip of a healthy shoot.

THE AMERICAN GOOSEBERRY-MILDEW

Sphærotheca mors-uvæ (Schwein.) Berk.

INTRODUCTORY.

The American Gooseberry-mildew, which has proved to be the most destructive pest known of the cultivated European gooseberry, is a disease of which hitherto the English fruit-grower has had no experience. This mildew is a native of America, and was unknown in Europe until the year 1900, when it was found in two counties in the north-east of Ireland. During 1900 to 1907 the disease has spread rapidly in Ireland, and now occurs in hundreds of gardens and in no less than twenty-one counties. The disease is found to recur annually in the affected gardens and plantations with increasing virulence, and many cases are known where the crop has been ruined and the bushes so affected that they have had to be grubbed up and burnt.* Dr. Pethybridge, who has studied the disease on the spot, writes as follows† : “ As regards Ireland, it is no extreme view of the case to state that the losses have been in many cases most serious, and unless the disease is checked, we are threatened with nothing less, practically, than the total loss of the profitable cultivation of the gooseberry as a bush fruit.”

Since 1900 the mildew has appeared on the Continent in Russia, Norway, Sweden, Denmark, Germany, and Austria-Hungary; and has spread like an epidemic through the gooseberry plantations, in many cases destroying the whole of the crop. In some districts in Sweden the cultivation of the gooseberry has been temporarily abandoned.

* See Journal of the Royal Horticultural Society, vols. xxv. (1900) xxvi. & xxvii. (1902); xxix. (1905); & xxxi. (1907).

† *Irish Gardening*, April, 1907.

During last winter the disease was discovered in an English nursery on standard gooseberry plants on the *Ribes aureum* stock; also in commercial gooseberry plantations in Worcestershire and Gloucestershire.

The American Gooseberry-mildew has been introduced into Ireland and the Continent on diseased gooseberry stock imported from America, and into England on diseased gooseberry bushes and standard gooseberries obtained from the Continent.

In America the disastrous effect of the present disease on the cultivation of the gooseberry can be gathered from the following extracts taken from the most reliable scientific sources: "The American Gooseberry-mildew is the most serious obstacle to the successful culture of the foreign (European) Gooseberry in the United States. On approaching the Middle States, although the bushes grow vigorously and set abundant crops of young fruit, the latter becomes covered with a thick brown or grey mildew or scurf, which destroys their value." "The mildew is the one great enemy of the gooseberry in the United States. It not only attacks the fruit, but often extends over the whole plant, effectually checking its growth. So prevalent has this become that the foreign varieties are almost universally discarded, as there are few localities where they will succeed."* "The one great hindrance to the cultivation of European Gooseberries in America is their susceptibility to attacks of the American Gooseberry-mildew. It is safe to say that were it not for the danger of loss from attacks of this mildew, the European varieties would be largely planted in this country in commercial plantations, but because of the ravages of this disease efforts to grow them on a commercial scale are usually soon abandoned."†

In some countries on the Continent, legislative measures—temporarily forbidding the importation of gooseberry stock, and enforcing the destruction (with compensation) of diseased plantations and the spraying of adjacent bushes—were employed against the disease directly on its appearance. In this country a Bill ("The Destructive Insects and Pests Act, 1907") to deal with the

* Report Commiss. Agric. 1887 (Washington, 1888).

† New York Agric. Exper. Station, Bull. No. 114. (1897); and *in litt.*

present disease, is now being introduced into Parliament. It is not expected, however, that this Bill will, if passed, come into force for some months. In the meantime, as pointed out below, the disease will spread rapidly from the infected plantations in this country unless the most resolute preventive measures are taken.

It will depend upon what steps are now taken by growers against the American Gooseberry-mildew whether the gooseberry plantations of this country are to remain healthy, or whether this new disease, which has just reached England, is to be allowed to invade them, in which case they will in all probability be destroyed by this fungus, just as Black Currant plantations have been destroyed by the "big bud" mite.

Description of the American Gooseberry-mildew.

The disease is first noticed during the last half of May or the first half of June on the young leaves or green berries, the parts affected becoming covered over with a white powdery mildew or "mould." When the attack is severe, the young mildewed gooseberries are prevented from developing, often becoming one-sided or more or less distorted. The disease spreads quickly over the fully-grown leaves, and also over the tips of the shoots, covering both with a white powdery "mould," very similar to the Hop-mould, or the mildew of the Rose.

It is in this stage, called the summer-stage, that the American Gooseberry-mildew spreads so rapidly through the plantation. If we place a piece of the mildew under the microscope, we shall see that it consists of numerous delicate white interlaced threads, or *hyphæ*, which creep over the surface of the leaf or berry, and send innumerable little suckers, or *haustoria*, into it. By means of these suckers the mildew obtains its food from the sap of the leaf or berry. These *hyphæ* form collectively the spawn, or *mycelium*, of the fungus.

During the summer-stage, upright branches, each bearing a long, necklace-like chain of summer-spores or *conidia*, are produced from the *hyphæ* of every patch of mildew. These are shown very much magnified in Plate II. fig. 1. Many hundreds of these chains of spores are produced in continuous succession night and day,

throughout the summer months, so that thousands of spores are produced. When ripe, the chain of spores falls apart, and it is the accumulation of thousands of separate minute spores which gives to the mildew its characteristic powdery or floury appearance. Each spore on reaching a healthy leaf or berry is able to infect it at once, and within a few days produces a fresh patch of mildew. The spores, being very small and light, are easily blown about by the wind, or carried by rain or insects, or on the tools or clothes of people moving in the plantation, and so the disease is quickly spread.

Later in the summer when the winter-stage is produced, the fungus alters entirely in appearance; it is now no longer white, but has changed to dark-brown, and forms dark scurfy blotches or scabs on the ripening berries, which render the crop absolutely useless. In Plate III. we have a photograph of a gooseberry branch, sent last season from Ireland, on which the two ripening berries show the scurfy blotches of the American Gooseberry-mildew in its winter-stage. In Plate V. we have photographs of other diseased berries, also sent from Ireland; one healthy berry is shown, while the rest are more or less completely covered over with patches of the brown felted scurf-like spawn of the mildew.

If we take a piece of this scurf-like spawn from the berry, and tease it out with needles in a drop of water under the microscope, we shall find that it is composed of a dense felt of interwoven brown thick-walled threads as shown in Plate II. fig. 3; and in the meshes of this felt we shall find many hundreds of little black or dark-brown globular bodies, looking like little black specks. These globular bodies are the fruit-conceptacles, or *perithecia*, of the fungus (see Plate II. fig. 4). They remain closed through the winter months, their thick walls protecting the contents from injury by frost, etc. Each fruit-conceptacle, on being greatly magnified, is found to contain a very thin transparent sac, or *ascus*, shown in Plate II., fig. 5, and in this sac are eight microscopic oblong winter-spores, or *ascospores* (fig. 6).

The mildew also attacks the wood of the young shoots. As these shoots are formed in the summer, their tips become covered first with the mildew in its white powdery summer-stage, and then later with the dark-brown felted or scurfy coating of the winter-

stage, with its black fruit-conceptacles containing the winter-spores. Plate I, fig. 3 represents a healthy gooseberry shoot; figs. 1, 2 and 4 show mildewed shoots obtained from Worcestershire. In fig. 4 we see the mildew forming greyish patches on the wood; in figs. 1 and 2 the mildew has passed fully into the winter-stage, and now coats the stem with a dark-brown felted scurfy covering. This scurfy covering, which consists of the spawn of the fungus bearing the fruit-conceptacles with the winter-spores, either forms blotches scattered over the surface of the wood towards the tip of the shoot, as in Plate I, fig. 2, or it completely invests the tip of the shoot for a distance of some inches, in which case the tip usually becomes more or less shrivelled up from the injury inflicted, as in Plate I, fig. 1. In Plate IV. we have a photograph of a diseased shoot sent from Ireland; the dark-brown scurfy blotches of the spawn of the mildew are conspicuous on the wood, and the tip of the shoot has been attacked and destroyed.

This brown felted scurfy covering can be scraped off with the finger-nail, and is absolutely conclusive evidence of the presence of the American Gooseberry-mildew. It may be mentioned here that in the case of the half-acre of gooseberries in Worcestershire where the disease was first discovered in England, it was almost impossible to find on any bush a shoot the tip of which was healthy.

It is important to note that the tips of gooseberry shoots which have been severely attacked by "green fly" (*Aphis*) bear a superficial resemblance to those attacked by the American Gooseberry-mildew. In the case of injury from "green fly," however, it is the actual surface of the shoot which has turned brown, whereas in the case of shoots attacked by the mildew, the brown colour is due, as noted above, to a superficial scurfy covering which can be peeled off.

The erroneous statements which have been recently published to the effect that the American Gooseberry-mildew has existed in Worcestershire for thirty years, are due to the fact that observers mistook the injury caused by "green fly" for that caused by the mildew.

Through the winter months the fruit-conceptacles, imbedded in the scurfy spawn on the young shoots and on the diseased berries which drop on the ground, remain closed, but in the spring, just

at the time when the gooseberry leaves are unfolding, they burst open and set free the winter-spores. In Plate II., fig. 4, we see a fruit-conceptacle (highly magnified) which is just bursting; when this happens, the contained sac (here seen protruding from the slit at the apex) swells and then ruptures, so that the eight winter-spores are forcibly ejected into the air. These spores are carried by the wind to the young leaves and berries, which they immediately infect, producing on them in the course of a few days the white powdery summer-stage of the mildew described above. When we remember that many hundreds of fruit-conceptacles, each containing eight winter-spores, are commonly found covering the tip of each shoot of an affected gooseberry bush, and are thus next season in close proximity to the opening leaves, it is easy to understand how it is that when once a plantation becomes infested with the American Gooseberry-mildew, the disease never leaves it, but reappears regularly every season.

The following varieties of gooseberries have been attacked in this country:—Keepsake, May Duke, Warrington, Lancashire Lad, Rushwick Seedling, Careless, Whinham's Industry.

The American Gooseberry-mildew attacks, besides the Gooseberry, the Red Currant, and has also been reported lately on the Black Currant and on the Raspberry.

It will be well to point out here that another mildew, viz., the European Gooseberry-mildew (*Microsphaera Grossulariæ* (Wallr.) Lév.), occurs on the gooseberry. Unlike the American Gooseberry-mildew, the European Gooseberry-mildew occurs only on the leaves, never attacking the berries* or the wood. The American Gooseberry-mildew, as noted above, occurs in the spring and early summer on the young leaves; the European Gooseberry-mildew is found only on the fully-grown leaves about the middle or towards the end of summer. The leaves attacked show scattered white patches of "mould," as illustrated in Plate VI.; if these patches are numerous, the leaf turns yellow, and falls prematurely. The microscopic details of the two mildews are entirely different.

* According to a recent article by Prof. Eriksson, small patches of the European Gooseberry-mildew have, very occasionally, been observed on the berry.

The European Gooseberry-mildew has been known in this country for many years, and is not a serious disease ; it must not be confounded with the American Gooseberry-mildew, which is just being introduced into England, and which has proved to be the most serious pest known of the cultivated Gooseberry.

Remedies.

Since it should be the object of English fruit-growers to stamp out this disease before it has gained a firm foothold in this country, nothing but the grubbing and burning of diseased bushes can be recommended.

In the winter it is useless to employ any of the ordinary winter washes, because the winter-spores are thoroughly protected from the spray by the thick walls of the fruit-conceptacles. Close pruning of the mildewed shoots, and the burning of the prunings, will of course tend to lessen the severity of the attack next season, but it cannot be expected that the disease will be stamped out by these measures.

In the spring and summer, spraying may be resorted to, but it can only be regarded as a preventive measure which may stop the disease from spreading, and cannot be relied upon to stamp it out.

It has been proved, by repeated trials on a large scale, in the United States, that the best spray to use against the summer-stage of the mildew is a solution of potassium sulphide ("liver of sulphur") at the rate of 1 oz. to 2 or 3 gallons of water. As the solution soon loses its strength, it should be made only just before using. The bushes must be thoroughly sprayed, and the spraying should commence just as the buds begin to unfold, and be continued at intervals of about ten days (oftener if heavy rain falls) throughout the season.

Whilst spraying with liver of sulphur during the spring and summer is to be recommended as a precaution in the case of bushes in the neighbourhood of diseased ones, it must be pointed out emphatically that there is evidence to show that it will be in the highest degree dangerous to rely on spraying as a means of eradicating the disease, or as a permanent practical remedy for dealing with the pest.

On the first point we have the testimony of Prof. Eriksson* to the effect that in the extensive experiments recently carried out in Sweden, spraying with liver of sulphur solution was found not only to cause injury to some varieties of gooseberries, so that the leaves, or even the berries, fell off, but it was also insufficient to stop entirely the development of the mildew, probably owing to the virulence of the disease having increased in consequence of its introduction into a new country.

On the second point, the following extracts may be quoted from a recent letter† written by Prof. S. A. Beach, (of the Iowa State College of Agriculture, U.S.A.), one of the highest authorities on the culture of the gooseberry in America :—

“ In spite of the fact that in the United States nurserymen have continually offered for sale the choicest varieties of English and Continental gooseberries, and that efforts have been continually made to grow European gooseberries here both in an amateur way and commercially, the cultivation of these gooseberries has never become permanently established upon a safe commercial basis, because of the destruction caused by the American Gooseberry-mildew. This is as true to-day as it was half-a-century ago. . . . In order to insure crops of fruit free from disease, as they must be if the business of gooseberry culture is to be placed on a reliable commercial basis, it has been found necessary to begin the treatment early in the season, and spray at intervals of from seven to ten days, always making the applications very thoroughly. The expense of such treatment is so great as to discourage the commercial growers, as is evidenced by the fact that although it is nearly thirty years since a reliable remedy for the mildew was discovered, the English gooseberries are not being cultivated commercially to any considerable extent in America.”

Concluding Remarks.

The present state of affairs, and the necessity for prompt action, with respect to this new pest now threatening Gooseberry

* See *Deutsche Landwirtschaftliche Presse* (translated in the “Gardeners Chronicle,” Nov. 3, 1906).

† See *The Standard*, March 20, 1907.

cultivation in England, may be best realised by reference to another disease, viz., the "big bud" caused by the Black Currant mite.

The American Gooseberry-mildew is as yet known only in about thirty plantations in Worcestershire and Gloucestershire. If at the present time the "big bud" disease was similarly confined in this country to thirty plantations, English fruit-growers, as the result of an experience which has cost them thousands of pounds incurred in grubbing Black Currant plantations, would certainly be anxious to see that these diseased bushes were destroyed before the disease spread through the country. English fruit-growers have had no experience of the American Gooseberry-mildew, but they should profit from the experience of the growers in America, in Ireland and on the Continent, who have seen their Gooseberry plantations ruined by this disease.

English fruit-growers will be pursuing a short-sighted policy if they do not unite and take energetic action at the present time to urge the Board of Agriculture to carry out the following measures : (1) the prohibition of all further importation of diseased gooseberry stock ; (2) the compulsory destruction of all diseased bushes, compensation being paid where necessary. Fruit-growers' Associations and Farmers' Clubs throughout the country should send repeatedly such resolutions to the Board.

Meanwhile, for the next few years, every grower should keep a sharp look-out for the disease in his plantations, and report immediately any outbreak.

May, 1907.

E.S.S.

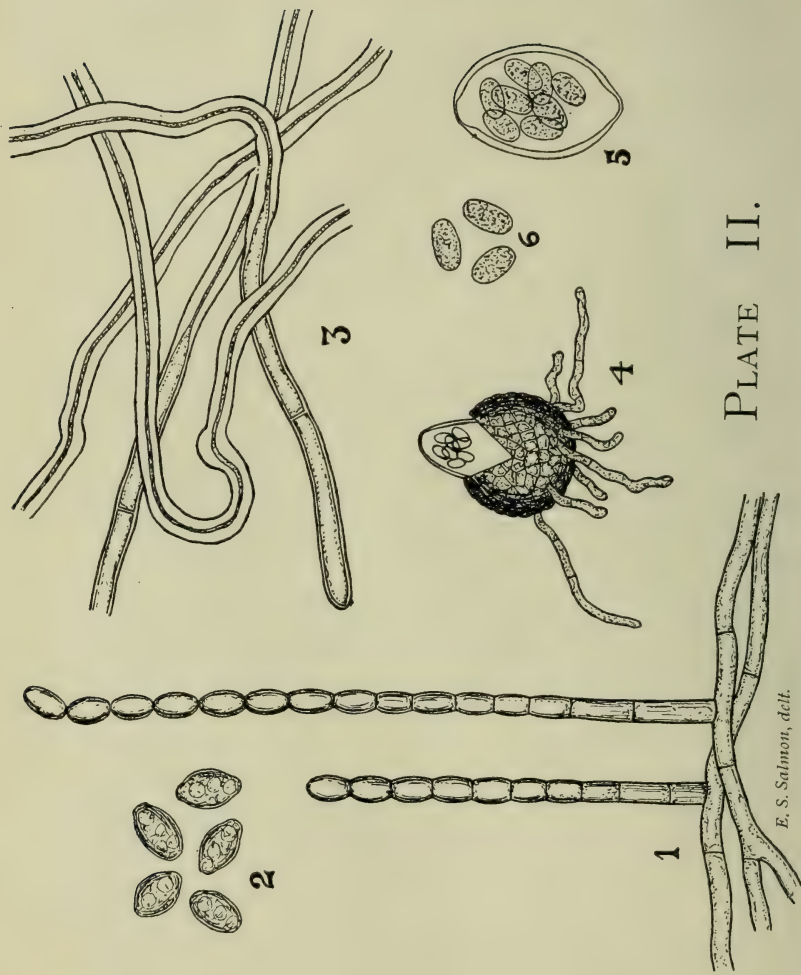


PLATE II.

E. S. Salmon, del.

MICROSCOPIC DETAILS OF THE AMERICAN GOOSEBERRY-MILDEW

Figs. 1, 2.—The summer-stage; 1, threads (*hyphae*) of the spawn (*mycelium*), with two upright branches, each bearing at the apex a chain of spores (*conidia*); 2, free spores, more highly magnified.
Figs. 3-6.—The winter-stage; 3, some of the brown thick-walled threads, of which the brown scurfy patches are composed; 4, a fruit-conceptacle, bursting; 5, a sac or *ascus*; 6, free winter-spores (*ascospores*). All the figures are highly magnified.

PLATE III.



[W. H. Hammond, photo.]

Gooseberry branch, with two nearly ripe berries, which are covered with the scurfy blotches of the American Gooseberry-mildew. (From Ireland.)

PLATE IV.



[W. H. Hammond, photo.]

Gooseberry shoot attacked by the American Gooseberry-mildew; the numerous dark-brown scurfy patches of the spawn of the mildew can be seen on the stem.

PLATE V.



[W. H. Hammond, photo.]

Six nearly ripe gooseberries, which have been attacked by the American Gooseberry-mildew ; one healthy berry shown.
(From Ireland.)

PLATE VI.



[W. H. Hammond, photo.]

Gooseberry leaves showing the white patches of the European
Gooseberry-mildew.

“ Brown Rot ” of Acid Cherries

(*Sclerotinia* (*Monilia*) *fructigena*).

Although, as I have personally observed, this disease is so common on Acid Cherries (Kentish, Morello, Flemish, etc.) in Kent, that it is no exaggeration to say that it is the exception to find an orchard in which all the trees are perfectly healthy, yet its presence is hardly ever even suspected by the grower, because the injury caused by this fungus is generally attributed to the action of frost.

The characteristic signs of the presence of this disease in a tree are the prevalence of dead wood (caused by the dying back of branches each year) and the shrivelled remains of flower-trusses and leaves hanging on the branches, which give the tree an untidy and unthrifty appearance.

It is a special characteristic of the Brown Rot fungus that it attacks the tree when it is in flower. If we keep an Acid Cherry tree—which by the presence of dead wood and shrivelled remains of flowers proclaims itself to be suffering from the present disease—under observation through the season, we shall find that at the period of blossoming, the flowers on some of the branches suddenly hang limp, and then wither, and turn brown, and die, while neighbouring branches remain in full flower. The photograph of an Acid Cherry in flower, given in Plate VII., shows the Brown Rot fungus attacking one of the branches. The branch below is still healthy and in full flower, while the branch above has been attacked, and the flowers killed.

At the first glance at such a tree, it might be thought that the affected branches had been injured by frost, and, as mentioned above, growers almost invariably do attribute the injury caused by the present fungus to the action of frost. But a more careful consideration of the facts will show that we are not dealing with any frost injury. In the first place, the flowering branches which are "struck," and whose flowers wither and die, are not usually those which are most exposed, but are more frequently those in sheltered positions. Further, if we examine the withered remains of the flowers hanging on the branches, we shall find the actual fungus which has killed the flowers. In Plate VIII. we have a photograph of a single flower (enlarged) taken from one of the dead flower-trusses of the withered branch shown in Plate VII. We can see here, covering the flower-stalk and the remains of the flower itself, the little greyish, powdery masses of the very minute spores of the Brown Rot fungus.

Those branches whose flowers have been "struck" die, the fungus gradually killing the wood. During the following winter and spring, little grey cushion-like pustules of spores are formed on the dead branches, either on the shrivelled remains of the flowers, or on the branch itself. (See Plate IX.). Next season, at the time of flowering, spores from these pustules are carried by the wind or insects to the flowers, which being at once attacked and killed by the fungus, present the appearance of being struck by frost. Thus, again, we have certain branches being killed, and the production of more and more dead wood (on which spores will be produced) taking place. The disease, having once obtained a firm hold, rarely leaves the tree, with the result that each year the yield of fruit is less, while the accumulation of dead wood increases until the stage is reached when the tree is killed, or is cut down as being entirely unprofitable.

Diseased trees can be quickly restored to health by spraying with Bordeaux mixture.* The first spraying should be given just before the flowers open; the second spraying directly after the flowers have fallen. Then—and this is an important point—in the autumn, before the leaves have fallen, as much dead wood

* A leaflet giving directions for preparing this mixture can be obtained by applying to the Secretary.

as possible should be cut out and burnt. If the above measures are taken for two successive seasons, badly diseased and dying cherry-trees will be completely restored to health and full productiveness.

Last season a demonstration spraying experiment against this disease was carried out at Egerton, near Pluckley, Kent. The orchard selected belongs to Mr. Isaac Stevens. In this orchard there were twenty-nine Flemish cherry-trees, all severely attacked by the Brown Rot fungus. The characteristic signs of the disease were very evident; there was a considerable quantity of dead wood, which had been accumulating year by year, and it was quite plain,—as Mr. Stevens himself pointed out—that the trees were becoming so unhealthy that unless some remedial measures were taken, they would be dead in a few years. Here, as elsewhere, the injury had been attributed to frost.

Using the College spraying apparatus,* two thorough applications of Bordeaux mixture were given to nine of these trees, the first just before the flowers had opened, and the second just after the blossom had fallen. The remaining twenty trees were left unsprayed, and served as a control. The beneficial results were soon visible on the sprayed trees, very few of the flowering branches being “struck”—while in the unsprayed trees the destruction of the flowers and afterwards of the whole branch continued unchecked.

Mr. Stevens writing to me reports that when the fruit was gathered, that from the sprayed trees was measured against that from the unsprayed trees, and states, “We picked from the nine sprayed trees eight-and-a-half bushels, and a little more than eight-and-a-half bushels from the twenty unsprayed trees, so that the crop was very plainly more than doubled by the spraying, which I think is very satisfactory.” In the autumn Mr. Stevens cut out most of the dead wood from the sprayed trees, and these nine trees, instead of presenting a diseased and dying appearance as they did a year ago, are now nearly restored to health and full productiveness. I may add that Mr. Stevens is so pleased with

* The “Pomona” pump, obtained from The Goulds Manufacturing Co., of New York, U.S.A., was used, mounted on a 40-gallon barrel, and fitted with the “Seneca” nozzle supplied by the same firm. The Bordeaux mixture was applied in a fine mist-like spray, by men trained by Mr. Deadman in the College plantations.

the results obtained by this spraying, that this season (1907) he has sprayed the whole of his plantations of fourteen acres.

Mr. Stevens gives me permission to say that he will be pleased to show the trees to any one wishing to see them.

The Brown Rot fungus attacks, besides Acid Cherries, Sweet Cherries, Plums and Apples. On Sweet Cherries and Plums especially, it often does very considerable damage. It is frequently the case that where a few Acid Cherries are planted in a large orchard of Sweet Cherries, the disease obtains a firm hold on the former, and then spreads to the Sweet Cherries, when the productiveness of the orchard may be greatly impaired. The characteristic signs of the presence of the fungus on Sweet Cherries are very similar to those described above on Acid Cherries, viz., the increasing accumulation of dead wood, and the withered remains of the flower-trusses hanging on the branches. "Gumming" often occurs at the places where the flowers have been killed.

Cherry Leaf Scorch

(*Gnomonia erythrostoma* (Pers.) Aueršw.).

In the last number of the Journal I gave an account of this disease, which at the present time is still seriously affecting the cherry orchards in certain districts of Kent. Orchards attacked by the fungus can be at once recognised in the winter and early spring months by their peculiar appearance, due to the fact that the dead leaves are still hanging on the branches of the trees. These dead leaves, which have been killed by the present fungus, remain firmly attached to the branch right through the winter on to the summer, and are usually to be found for several weeks after the flowering of the cherry.

A diseased leaf gathered in the winter months shows a number of minute black points scattered over its lower surface.* Each black point is the beak of one of the fruit-conceptacles of the fungus (see *d.* in Plate XV. (1). Each conceptacle holds a large number of

* Accompanying the Cherry Leaf Scorch fungus may be found almost without exception, a totally distinct fungus, which is distinguished by being much smaller and of a very distinct habit, being densely clustered (not scattered.) It is, I believe, a species of *Mycosphaerella*.

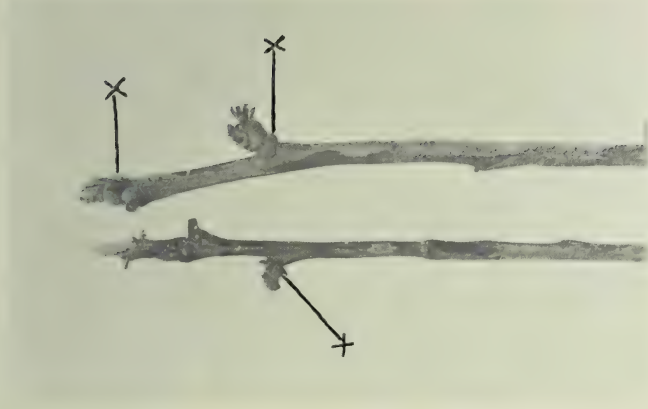


Photograph of two flowering branches of an Acid Cherry (Morello) ; the upper branch has been " struck " by the Brown Rot fungus.



[W. H. Hammond, photo.]

Photograph of a withered flower (enlarged) from the upper branch shown in Plate VII.; the greyish patches of the minute spores of the "Brown Rot" fungus can be seen covering the stalk and the remains of the flower.



[W. H. Hammond, photo.]

Two twigs of a Morello Cherry killed by the Brown Rot fungus; at X little greyish cushion-like pustules of spores have been produced.

minute sacs (*asci*), each containing eight winter-spores (*ascospores*). (See Plate XV. (1), where a conceptacle of the fungus is cut open down the middle, to show its contents; at 2 an *ascus* and four free *ascospores* are shown; at 3 four *ascospores* germinating after being kept for forty-eight hours in a decoction of plum juice).

In the autumn the conceptacles are immature, but during the winter months they gradually ripen, until by spring (just at the time when the new leaves of the cherry are unfolding), being perfectly ripe, and ready to infect a leaf, they are ejected with considerable force from the mouth of each conceptacle. Owing to the old dead leaves remaining attached to the branch, the spore-ejecting conceptacles are in close proximity to the new leaves. In Plate XIII. we see at the base of the flowering shoot a number of old dead leaves; each of these leaves, it must be noted, bears ripe fruit-conceptacles of the fungus, while just above the young leaves of the cherry are unfolding. When we remember that each diseased leaf bears many hundreds of fruit-conceptacles, and that each conceptacle contains a large number (50 to 100 or more) of sacs, each with eight spores, it is easy to understand how the re-infection of the leaves of a tree takes place regularly year after year, unless preventive steps are taken.

When one of the winter-spores reaches the surface of a young leaf, it immediately germinates, pierces the epidermis, and gives rise within the leaf to a vegetative spawn (*mycelium*). This spawn spreads among the leaf-cells, and feeds on them. Large yellow flecks* are formed, which soon turn brown, and then the whole leaf dies, shrivelling up and presenting a scorched appearance. During the summer the fungus also invades the cells of the leaf-stalk, killing the cells right down to the branch on which the leaf is borne. Now in the case of a healthy leaf, it is the cells at the base of the leaf-stalk which play the chief part in the process of the detachment of the leaf in the autumn. It is in consequence of the growth of the fungus down the leaf-stalk, and the injury it inflicts there, that the normal process of defoliation is made impossible, with the result that the leaf, now killed by the fungus, remains firmly

* During the summer small conceptacles, filled with long curved spores, develop on these yellow spots. This is known as the *Septoria*-stage of the disease.

fixed to the branch until it rots away in the course of the following summer.

In Plate XIV. we see that even at the time when the young fruit is forming, the boughs of an infected tree still carry the diseased leaves of the previous season. The cherry itself is often attacked, when it either soon falls off, or becomes more or less distorted, and develops hard spots in the flesh.

Trees which have suffered from the disease for a number of years, show weak growth of wood, due to the leaves having been infested by the fungus through the summer months, and so prevented from carrying out their normal functions in assisting the growth and ripening of the wood ; an increasing quantity of dead wood accumulates, and finally the tree dies.

In my article in the last number of the Journal I gave a detailed account, from personal investigation, of the affected areas where the disease is prevalent. The area of country which, so far as my investigations then showed, was invaded by the fungus, lies, roughly speaking, within an oval, the bounding line of which runs from Paddock Wood through Maidstone nearly to Sittingbourne, thence a little south of Faversham, nearly to Canterbury, and back, keeping a little north of Ashford, to Paddock Wood.

During the past season the disease, so far as I have investigated, still persists in all the localities where it was noted previously, and in some orchards the leaves were hanging thicker last winter than before, scarcely a leaf having been thrown off from the trees in autumn.

I have observed the disease this winter on Wild Cherry trees (*Prunus Avium*) close to Olantigh Park, near Wye, and in some copses about Crundall, a few miles to the east of Wye ; also on cultivated cherries, in a garden at Coleman's Hatch, in Sussex.

The disease is very prevalent in orchards along the Lower Greensand (" Ragstone ") range of hills from Pluckley, through Ulcombe to Otham, Langley and Leeds. In Plate X. we have a photograph showing the general appearance of a diseased orchard. This orchard is at Pluckley, and can be taken as typical of the unhealthy condition into which a large number of cherry orchards in certain districts of Kent have now been reduced by the attacks of the Cherry Leaf Scorch fungus. On inquiry it is found that

only a very poor crop of fruit, or frequently no crop at all, has been obtained from these orchards since they have been affected. Further, the injury done to the trees, as evidenced by the leaves adhering to the branches, instead of falling in the autumn, is almost invariably attributed by growers to the action of frost, and we find, consequently, that no efforts are being made to remove the real cause of the disease.

Remedies.

The fungus depends absolutely for the continuance of its existence on fresh infection taking place in the spring by means of the spores scattered from the fruit-conceptacles of the fungus on the dead leaves hanging on the tree. The spawn of the fungus stops short at the base of the leaf-stalk, and never enters the branch, so that no wood becomes diseased. If, therefore, during autumn or winter the dead leaves hanging on an affected tree are collected and destroyed, that tree is perfectly free from disease again.

An epidemic of the present disease occurred about 1880 over an extensive area of country between Harburg and Stade, in one of the best fruit-growing districts of Prussia. After the disease had ravaged the orchards for six years, and increased in virulence to such an extent that in many orchards not a single leaf fell from a tree in the autumn, and the cherry crop was as good as destroyed, the Government stepped in, and put the matter in the hands of Prof. B. Frank, an eminent mycologist of Berlin. Prof. Frank, who was the first to work out the life-history of the fungus, recommended the collection and burning of the diseased leaves (hanging on the trees) over the whole of the affected district. The Government followed his advice, and dealt with the matter energetically, Government notices being posted over the whole district enforcing the compulsory picking off and burning of the dead leaves before the middle of February. These measures (which at first met with much opposition, due to the ignorance of the fruit-growers, but which finally were given hearty support), were carried out for two successive seasons, and proved entirely successful; in the third season, all the cherry orchards—for the first time for eight years—stood healthy again, and completely restored to their former productiveness.

In my article last year I wrote :—

“ Another way of dealing with the present disease would be to prevent the infection of the leaves in the spring by covering them with a coating of Bordeaux mixture. An experiment on these lines is now being carried on at Pluckley. It must be pointed out, however, that so long as the disease is allowed to flourish generally in the numerous orchards of the affected districts, frequent annual sprayings will always be required to keep adjacent orchards clean, and the root of the evil will remain practically untouched.

“ On the other hand, the cost of picking off the dead leaves is considerable in the case of large trees, and it must be carefully borne in mind that such preventive measures can be successful only if rigorously carried out co-operatively over the whole of the affected district.”

I have now to record the result of this spraying experiment at Pluckley.

Thirteen trees were chosen, standing in the middle of an affected orchard (such as that shown in Plate X.) belonging to Mr. A. Pearson, of Pevington, Pluckley. Using the College spraying apparatus,* these thirteen trees were thoroughly sprayed with Bordeaux mixture.† The first application was given just before the flowers opened, and the second soon after the flowers had fallen. Nothing more was done to the trees. In the following winter the surrounding trees were as badly affected with the disease as ever, the majority of the leaves remaining unshed. Plate XII. shows a photograph of one of the unsprayed trees standing in the next row to the sprayed trees. The thirteen sprayed trees presented the appearance shown in Plate XI., which shows a photograph of one of them; only a few leaves remained unshed from the branches, and the trees consequently were nearly restored to health again.

The great improvement shown by the tree in Plate XI. as compared with that in Plate XII. was obtained simply by two thorough applications of Bordeaux mixture, and when it is remembered that this tree (and the remaining twelve trees which presented the same appearance), stood throughout the season

* See footnote to page 285.

† A leaflet giving directions for preparing this mixture can be obtained by applying to the Secretary.



General view (*in winter*) of a Cherry Orchard attacked by the Cherry Leaf Scorch fungus ; showing the leaves still hanging on the trees.

PLATE XI.



CHERRY LEAF SCORCH.

After two sprayings with Bordeaux mixture.

(Compare Plate XII.)

PLATE XII.



CHERRY LEAF SCORCH.
Unsprayed.
(Compare Plate XI.)

PLATE XIII.



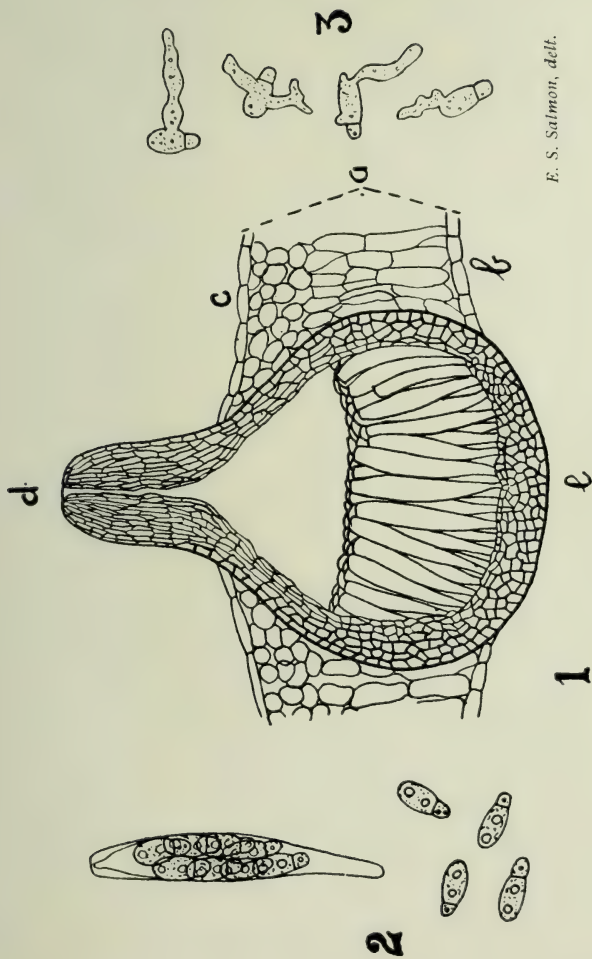
[I. E. Salmon, photo.]

Photograph of a flowering branch of a Cherry-tree attacked by the Cherry Leaf Scorch fungus. The old dead leaves, seen below the flowers, have remained attached to the branch through the winter, and bear many hundreds of the fruit conceptacles of the fungus. These conceptacles become ripe during the spring, and forcibly eject spores, which infect the young unfolding leaves, seen above the flowers.

PLATE XIV.



Photograph of a diseased Cherry branch, with young cherries; the dead, withered leaves of last season, still firmly attached, are seen at X. These dead leaves bear the fruit-conceptacles of the Cherry Leaf Scorch fungus, and spores from these are blown on to the young leaves and cherries, which they immediately infect.



E. S. Salmon, *delt.*

THE CHERRY LEAF SCORCH FUNGUS (*Gnomonia erythrostoma*).

- (1) Section of a diseased Cherry leaf, cutting through the middle of one of the fruit-conceptacles of the fungus; *a*, the cells of the leaf; *b*, the upper surface of the leaf; *c*, the lower; *d*, beak of the conceptacle of the fungus; *e*, its base. Within the conceptacle can be seen the crowded mass of little sacs (*asci*).
- (2) One of the *asci* more highly magnified, showing the eight winter-spores (*ascospores*) it contains; also, below, four free *ascospores*.
- (3) *Ascospores* germinating after being kept in a decoction of plum-juice for 48 hours.

surrounded by diseased trees, and thus exposed for many weeks to continual infection, the efficacy of this fungicide against the present disease is clearly demonstrated. An even quicker and more complete recovery of affected trees might be expected in a case where the whole orchard was thus sprayed.

It is intended that a further spraying shall be given to these thirteen trees this year, and that similar experiments shall be made in other orchards.

If, as seems almost certain, we can eradicate this disease by a few thorough sprayings with Bordeaux mixture, then the owners of the numerous cherry orchards (scattered over a considerable area in Kent) now becoming unproductive in consequence of the injury caused by the Cherry Leaf Scorch fungus, have in their hands a cheap and easy method of quickly restoring them to health.

Apple Scab or "Black Spot"

(Conidial stage, *Fusicladium dendriticum* Fckl.)

(Ascigerous stage, *Venturia Pomi* (Fr.) Wint.)

From the numerous communications received, and from personal inspection of orchards and plantations, it is quite clear that very heavy losses have been, and are being, caused to apple-growers in Kent and Surrey through the injury to the crop caused by the Apple Scab or "Black Spot" fungus. From all accounts the disease has increased in intensity during recent years, and evidence is to hand showing that in many instances certain varieties of apples which have hitherto kept free from the "Black Spot" have during the past few seasons become subject to the disease.

In view of the widespread losses, it cannot be too emphatically pointed out that the present disease is one which can be effectively dealt with by spraying.

In connection with Apple Scab or "Black Spot" the grower must remember two important facts. In the first place, it must be remembered that this fungus lives during the summer months on the *leaves* of the apple, passing from these on to the fruit. Secondly, that the fungus frequently attacks the *young wood* of certain

varieties of apple, and in such cases lives there during the winter, and then in the spring passes on to the young leaves and the young fruit.

In Plates XVI. and XVII., we see photographs of young apples attacked and ruined by the "Black Spot" fungus. On young fruit such as this the fungus finds exceptionally favourable conditions for its growth, and, feeding voraciously on the sap of the young apple, is able to extend its growth over half or more of its surface, gradually draining it of the food necessary for its growth and ripening, so that the apple is never able to reach its normal size, but remains flattened or deformed on the attacked side (see Plate XVI., to right (below), or becomes cracked and more or less distorted. (See Plate XVII.).

When older apples are attacked, or when the young apple is attacked so slightly that it is able, to some extent, to grow away from the disease, the ripe apple is found to be disfigured by the presence of roundish black spots, which are frequently surrounded by a whitish rim.

Now in cases where the young apples are severely attacked it will be found either that the surface of the leaves of the tree show this same fungus, or that the young wood of the tree, or, it may be, of neighbouring trees of another variety, is harbouring it. The general appearance of the disease on the leaf varies according to the variety of apple; in all cases, however, the part of the leaf which actually bears the fungus becomes of a dark olive-green, or sooty colour. Sometimes the fungus is confined almost entirely to the veins of the leaf, as in Plate XVIII., B.; in other cases it forms distinct and sharply marked patches scattered over the upper or under surface of the leaf as in Plate XVIII., A.; sometimes, again, it extends almost continuously over the entire surface of the leaf, as in Plate XIX., B.; or, finally, as, for example, on the leaves of Warner's King, the fungus may cause raised blister-like spots scattered over the upper surface of the leaf (Plate XIX., A.).

Now, at every place where these dark patches appear on the leaf the fungus produces myriads of *spores* throughout the summer months until the leaf falls. A drawing of a section, highly magnified, through a part of one of these patches is shown in Plate XXII.

The epidermal cells of the apple-leaf are shown at *a* ; at *b* is the spawn or *mycelium* of the fungus, which is feeding entirely on substances absorbed from the cells of the leaf ; at *c* are three *spores* of the fungus. These minute *spores* are produced in countless numbers, and being easily blown about by the wind, and carried by rain or insects, quickly spread the disease from leaf to leaf through the orchard or plantation. The spores from the leaves reach the fruit, and immediately infect it, producing the well-known Scab or "Black Spot."

As mentioned above, another source from which the disease reaches the fruit may be the young wood. The young wood attacked by the fungus presents a blistered appearance, due to the presence of numerous blackish pustules of spores, which break out through the bark. The exact effect produced varies somewhat according to the variety of Apple attacked and the virulence of the disease. A diseased shoot of Cox's Orange Pippin is shown in Plate XX., Fig. 1, A. ; on the wood of this variety the fungus produces a conspicuous blistered appearance. In Fig. 1, B., the variety of Apple attacked is "Wellington" ; here the evidence of disease is much slighter, the fungus breaking through the bark in small, inconspicuous, often scattered pustules. On "Lord Suffield," again, the effect produced on the wood may be very marked. I have seen cases with trees of this variety, where the disease was of long standing, and little pruning had been done, where the shoots had become so full of the fungus that the bark was ruptured over comparatively large areas, and was beginning to peel off in flakes. (See Plate XX., Fig. 2). Such affected areas are sometimes swollen and blistered, and then they superficially resemble those produced in the fungus disease known as "canker."

On several farms, too, I have seen the young wood of young trees of "Cox's Orange" covered with conspicuous scabby patches due to the attacks of the present fungus, with the blistered bark beginning to peel off in flakes ; and in some cases the young wood of this variety has actually been killed.

If one of the pustules of spores on an Apple twig affected by "scab" is cut across and examined under the microscope, we find the structure shown in Plate XXI. Here we see some of the cells of the Apple twig shown at *a* ; seated on these cells is a compact

mass of fungus tissue, shown at *b*. This cushion-like mass of fungus spawn has pushed its way through the bark, which it eventually ruptured, and produced over its surface myriads of very minute brownish spores (*c*). These spores are capable of germinating immediately, and during the spring and early summer are blown from the diseased wood on to the leaves and young fruit, and immediately infect them, producing on the latter the well-known "Scab" or "Black Spot."

Now that the winter-stage on the wood has been discovered, it must carefully be borne in mind that, in all probability, plantations which have suffered for several seasons from Apple Scab *are never wholly free from the disease at any time of the year*, as the fungus will persist in its winter-stage on the young wood of certain varieties of Apple in the plantation. Where "scab"-diseased wood is present in an Apple plantation in the winter, it is practically certain that during the following summer the fruit will suffer from "scab." In such plantations the grower should pay special attention to the varieties that show diseased wood, cutting out in pruning as much as possible of the diseased wood.

I have found Apple Scab on the *wood* of the following ten varieties :—Yellow Ingestre or Summer Pippin (very bad) ; Lord Suffield (very bad ; in cases where the trees had been neglected, ruining the trees) ; Ecklinville Seedling (very bad) ; Cox's Orange Pippin (very bad) ; Wellington ; Cox's Pomona ; Warner's King ; Mr. Gladstone ; Councillor ; White Transparent.

In connection with the present disease numerous experiments on a large and commercial scale have been carried out by many of the Agricultural Experiment Stations in the United States and in Canada. Two facts stand out clearly as the result of the work done ; first, that Apple Scab or "Black Spot" is the most serious pest with which the Apple-grower has to contend, no other disease annually ruining such a large percentage of the crop ; and secondly, that the disease can be thoroughly controlled by spraying. Since, as mentioned above, the fungus occurs on the leaves, and sometimes also on the young wood, it is necessary for the grower to keep both clean if he wishes to grow clean healthy fruit. Plantations and orchards which have suffered severely from "Black Spot" should be sprayed three times with Bordeaux mixture (8 lbs. copper sul-

phate, 8 lbs. quicklime, 100 gals. water).* The first application should be made on the unfolding leaves just before the blossoms open; the second, just after the blossoms fall; the third, two or three weeks later. If the attacks of "Black Spot" have not been severe, the first spraying may be dispensed with. (If an insecticide is wanted, add Paris Green at the rate of one pound of Paris Green to 200 gallons of Bordeaux mixture; or arsenate of lead can be added to the Bordeaux mixture at the same rate per gallon as when water is used. The lime in the Bordeaux mixture neutralises any excess of free arsenic, and so makes it an excellent medium for arsenical sprays, since it removes all danger of scorching the foliage.) If further (later) sprayings are necessary to save the fruit from "Black Spot," it is not advisable to use Bordeaux mixture, but to use the ammoniacal solution of copper carbonate,* which does not stain the fruit.

Where the young wood has become diseased, a strong *winter* wash of copper sulphate or "bluestone" (4 lbs. copper sulphate, 100 gallons water) should be applied *when the tree is dormant*. It is only on trees where the young wood is diseased that this winter wash is necessary; to apply it indiscriminately to whole orchards is little less than pure waste of money.

If the leaves of apple trees are kept clean by systematic spraying, as directed above,—and where necessary, the young wood also, no trouble will be found in keeping the crop free from "Black Spot." During the past year (1906) the use of Bordeaux mixture, both in the College plantations and also by several fruit-farmers in different parts of Kent and Surrey, has been attended with marked success.

The present fungus seriously affects the fruit of the following varieties:—King of the Pippins, Worcester Pearmain, Cox's Pomona, Lord Grosvenor, Suffield, Ecklinville Seedling, Northern Greening, Wellington, Yellow Ingestre or Summer Pippin, Loddington Seedling, Domino. The attacks of the fungus on the above eleven varieties are frequently so severe as to quite ruin the market value of the fruit. The following varieties are also more or less susceptible:—Duchess' Favourite, or Duchess of Gloucester,

* A leaflet giving directions for preparing this fungicide can be obtained by applying to the Secretary.

Quarrenden, Allington Pippin, Bismarck (mainly on the leaves), Blenheim Orange, Warner's King, Cox's Orange.

It is to be noted that not only are those apples which are attacked by "Black Spot" ruined in appearance, and their market value much depreciated, but they are also affected very injuriously as regards their keeping quality. The injured spots and cracks produced on the apple become the places of entry for the spores of other fungi, which produce "ripe rots" of stored fruit.

The following nine varieties appear so far to have stood out as resistant to the present disease:—Beauty of Bath, Bramley's Seedling, Newton Wonder, Grenadier, Lord Derby, Lane's Prince Albert, Queen, The Victorian, Golden Spire.

Crown-Gall of Lucerne

(*Urophlyctis Alfatjæ* (v. Lagerh. olim) P. Magn.)

As recorded in the last number of the Journal, examples of this new fungus disease of lucerne were sent to the College in 1906, from an old piece of lucerne on a farm near Herne Bay, Kent.

A photograph of one of the diseased plants from this farm is shown in Plate XXIII. The warted gall-like swellings occurring on the crown of the root are due to the attacks of the fungus *Urophlyctis Alfatjæ*. Each of these galls consists of diseased tissue of the lucerne-plant, and contains interiorly a number of little chambers or cavities filled with the spores of the fungus. A photograph of a gall, cut across and showing these chambers, is shown, highly magnified, in Plate XXIV. The large, round resting-spores (40 *u.* in diam.) can be clearly distinguished in these chambers.

The following inoculation-experiments were carried out to demonstrate that the resting-spores, on being set free from the "gall" and dispersed in the soil, are able to produce at once the "crown-gall" of lucerne, and also to ascertain whether the fungus can attack other plants, such as mangold, potato, etc.

During the winter of 1905-6, a number of badly-diseased lucerne plants, covered with "galls," were obtained from the farm

PLATE XVI.



[W. H. Hammond, photo.]

Young apples attacked by the Apple Scab or "Black Spot" fungus; showing the arrested or one-sided growth.

PLATE XVII.



[W. H. Hammond, photo.]

Young apples attacked by the Apple Scab or "Black Spot" fungus ;
showing the cracking seen in severe attacks of this disease.

A



[U. H. Hammond, photo.]

B



[U. H. Hammond, photo.]

THE APPLE SCAB OR "BLACK SPOT" FUNGUS ATTACKING THE LEAF.

In A (under-surface of the leaves of "Bismarck") the fungus forms distinct blotches scattered over the surface and mid-rib. A healthy leaf is shown to the right.

In B the fungus follows more or less the course of the veins on the upper surface of the leaf.



[W. H. Hammond, photo.]

A



[W. H. Hammond, photo.]

THE APPLE SCAB or "BLACK SPOT" FUNGUS ATTACKING THE LEAF.

In A (upper surface of leaf of "Warner's King") the fungus has produced blister-like spots, the surface of which is covered with dark-brown spores.

In B the fungus has spread almost continuously over the whole of the upper surface of the leaf, giving it a sooty appearance. The dark parts here shown are not due to shadow, but to the dark-brown sooty covering formed of the spores of the fungus.

FIG. 1.



W. H. Hammond, photo.

THE APPLE SCAB OF "BLACK SPOT" FUNGUS ATTACKING THE YOUNG WOOD OF APPLES.

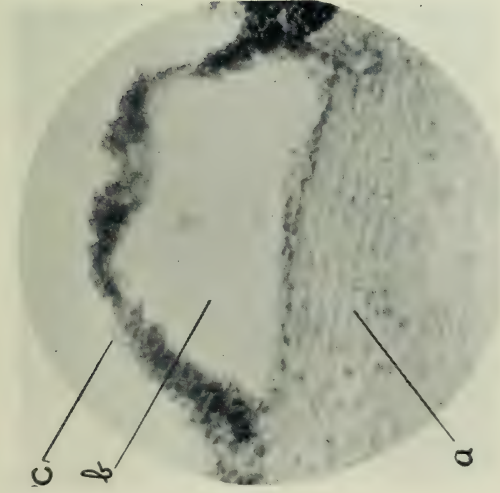
Fig. 1—A. On Cox's Orange Pippin; *a*, healthy wood; *b*, diseased wood, the blistered appearance being due to pustules of spores breaking through the bark. B. On Wellington; *c*, healthy wood; *d*, twig with diseased patch below.

Fig. 2. "Scab"-infected twigs of "Lord Suffield"; in places the bark is beginning to peel off in flakes.

FIG. 2.

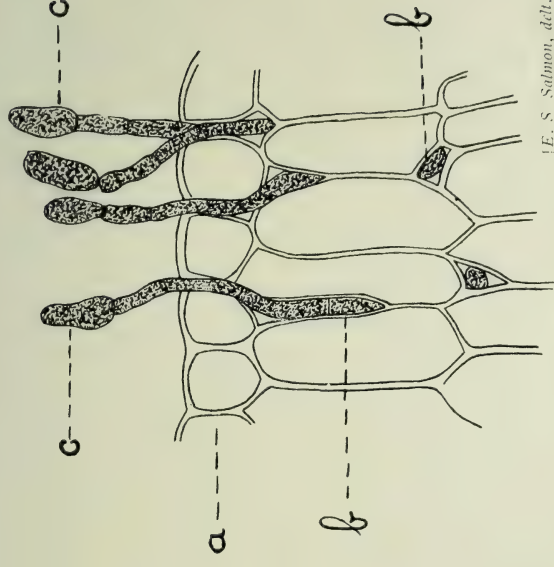


W. H. Hammond, photo.



[W. H. Hammond, photo.]

Microphotograph of a section of one of the pustules of spores from the diseased twig of Cox's Orange Pippin shown in Plate XX. ; *a*, cells of the twig ; *b*, cushion-like mass of fungus-tissue, which has pushed its way out through the bark, and produced over its free surface myriads of spores (*c*). Highly magnified.



[E. S. Salmon, delt.]

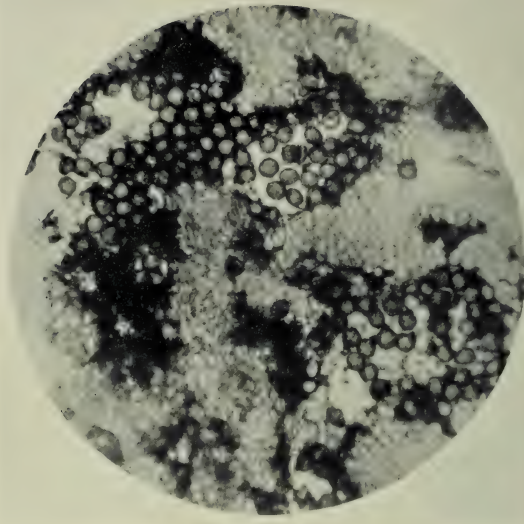
Part of a section through one of the patches of Apple Scab or "Black Spot" on a leaf of "Bismarck" shown in Plate XVIII. *A.* ; *a*, epidermal cells of the leaf ; *b*, portions of the spawn (*mycelium*) of the fungus feeding on the sap of the leaf ; *c*, ripe spores (*conidia*) of the fungus. Highly magnified.

PLATE XXIII.



[W. H. Hammond, photo.]
Photograph of the crown of a root of Lucerne, showing the "galls" formed by the fungus *Urophlyctis Alutiae*. Natural size.

PLATE XXIV.



[W. H. Hammond, photo.]

Microphotograph of part of a section of a "gall," showing the chambers filled with the spores of the fungus. Highly magnified.

PLATE XXV.



[S. T. Parkinson, photo.]

Two Lucerne plants which have been inoculated with the spores of the "Crown-gall" fungus (*Urophlyctis Alfalfae*); large "galls" have been produced at the crown of the root. In the centre is a "control" (uninfected) plant of Lucerne.

near Herne Bay. These "galls" were kept dry in the laboratory through the winter, and a number were then taken from time to time and first soaked in water, and then ground up in water with pestle and mortar. A drop of this water, on being placed under the microscope, was seen to contain many hundreds of the resting-spores of the fungus.

Six well-grown and healthy plants of lucerne, beet, mangold and potato, in 9½ in. pots, were richly inoculated with the spore-containing water, the water being poured not only over the crown of the roots and the surface of the pot, but also into a number of vertical "borings" which reached to half the depth of the pot. Six "control" pots of each kind of plant were kept side by side with the inoculated ones. All the pots were sunk in the earth in the experimental ground. Later in the season the twenty-four inoculated pots were again similarly inoculated. The dates of the two inoculations were chosen so that, in the case of each of the four plants, the first inoculation was made just as the first shoots appeared above ground, and the second when the shoots were full-grown for the season. In November all the plants were examined. On five out of the six inoculated lucerne plants* a number of "galls" had been produced, like those shown in the photograph in Plate XXV. In two cases the attack of the fungus had been so virulent that the lucerne plant was actually killed. No formation of "galls" occurred on the "control" lucerne-plants, nor on any of the inoculated or "control" plants of mangold, beet or potato.

The present disease had not been observed in England previous to the Herne Bay case in 1906, and no fresh case has since come under my notice. It will be well, however, for farmers to keep a careful look-out for this new disease, since in several countries on the Continent, and also in South America, it has proved to be very destructive to cultivated lucerne. So far as the present investigations show, it is safe to grow beet, mangold, or potatoes after lucerne which has suffered from this disease.

* These were two-year-old plants.

The European Gooseberry Mildew (*Microsphaera Grossulariæ*
(Wallr.) Lév.) **attacking the Red Currant.**

During October 1906 a white mildew appeared on the leaves of some Red Currant bushes in the College fruit plantations. Conspicuous white patches of the mildew occurred on the upper surface of the leaf, as shown in the photograph at Plate XXVI., and the minute fruit-conceptacles of the fungus,—looking like little black dots—occurred on these patches, as well as scattered over the under surface of the leaf. On microscopical examination the mildew proved to be the European Gooseberry-mildew (*Microsphaera Grossulariæ* (Wallr.) Lév.). From each fruit-conceptacle a number of minute processes or appendages radiate, while inside the conceptacle are a number of little sacs, or *asci*, each containing four or six winter-spores (*ascospores*). Each appendage is branched at its apex in a repeatedly dichotomous manner, characteristic of the species. Creeping over the surface of the leaf, and bearing these fruit-conceptacles is the mycelium or spawn of the fungus, composed of a number of very fine white threads, or *hyphæ*, which are branched and interwoven. Each hypha sends at frequent intervals a sucker, or *haustorium*, into an epidermal cell of the leaf by means of which the fungus obtains its nourishment, but the whole of the fungus is otherwise external to the tissues of the plant on which it is feeding. Hitherto this mildew has been recorded in Europe only on the Gooseberry, and it seems curious, considering how frequently Red Currants and Gooseberries are grown together, that the former plant has remained unattacked—or has never been recorded as being attacked—until this season. In the present instance the Red Currant trees attacked (of which there were some dozens) are young trees of the Raby Castle variety, and stand close to Gooseberry bushes attacked by the same fungus. The European Gooseberry-mildew, when it attacks Gooseberry bushes severely, may cause a premature shedding of the leaves; this can, however, be prevented by spraying with a fungicide, viz., potassium sulphide ("liver of sulphur"), 1 oz. to two or three gallons of water. The same fungicide should be used if the mildew becomes troublesome to Red Currants. It may be noted that this season, both in Ireland

PLATE XXVI.



[W. H. Hammond, photo.]

LEAF OF RED CURRANT,
showing the white patches of the European Gooseberry-
mildew.

and in Denmark, the Red Currant has been attacked—for the first time in Europe—by the American Gooseberry-mildew (*Sphaerotheca mors-uvæ* (Schwein.) Berk). (See p. 278.) I should be glad if anyone meeting with a mildew on the Red Currant would kindly forward me a specimen, with particulars of the outbreak.

THE AMERICAN GOOSEBERRY-MILDEW IN ENGLAND AND THE NEED FOR LEGISLATION.

The American Gooseberry-mildew (*Sphaerotheca mors-uvæ* (Schwein.) Berk.), of which a description, with illustrations, has been given above, has long been known and feared in America on account of the injury it causes in that country to cultivated gooseberries. This fungus alone practically prohibits the commercial cultivation of the European gooseberry in the United States.

The mildew was recorded for the first time in Europe in 1900, when it was discovered in a few gardens in two counties in the N.E. of Ireland. About 1901 it appeared on the Continent in Russia, Denmark, Norway, and Sweden, in 1902 in Poland, in 1904 in Finland, and in 1905 in Germany.

The disease appears to have been distributed in Europe from three distinct centres, viz., Ireland, Russia, and Denmark. According to the evidence which has been collected, the mildew has been brought into Europe, probably a little before the year 1900, on diseased gooseberry plants imported from the United States. In several cases of the outbreaks in Europe the source of the disease has been definitely traced to nurseries known to import gooseberry plants from America.

In each country in Europe where the disease has appeared, it has established itself firmly, and re-appeared annually with increased and often exceptional virulence, sometimes destroying the whole of the crop. The present case offers a close parallel to those of the invasion of Europe by other species of fungi, viz., in the forties by the Potato-blight (*Phytophthora infestans*, de Bary) and the Vine-Mildew (*Oidium Tuckeri* Berk.), in the beginning of the seventies by the Hollyhock-rust (*Puccinia Malvacearum*, Mont.), and at the end of the seventies by the False or Downy Mildew of the Vine (*Perono-*

spora viticola, de Bary). The four introduced diseases, above named, have since their importation into Europe, caused the loss of millions of pounds, and still each year carry on their destructive work ; it seems quite certain that the same will be the case with the American gooseberry-mildew if it is allowed to establish itself.

The American Gooseberry-mildew has been long known in America on a number of wild species of the genus *Ribes*, and on the introduction into America of the cultivated Gooseberry of Europe (*Ribes Grossularia*) it was found that this mildew attacked it with the greatest virulence.

The following extracts, taken from the most reliable sources, record the experience of both scientific and practical men.

Prof. B. D. Halsted, in his Report laid before the Commissioners of Agriculture at a meeting held at Washington, U.S.A., in 1887, makes the following statements: "The American Gooseberry-mildew is the most serious obstacle to the successful culture of the European gooseberry in the United States. In the extreme northern parts of the Union it is not formidable ; but on approaching the Middle States, although the bushes grow vigorously and set abundant crops of young fruit, the latter becomes covered with a thick brown or grey mildew or scurf, which destroys their value. . . . This mildew is the one great enemy of the gooseberry in the United States. It not only attacks the fruit, but often extends over the whole plant, effectually checking its growth. So prevalent has this become that the foreign varieties are almost universally discarded, as there are few localities where they will succeed."

Prof. C. P. Close, in Bulletin No. 161 of the New York Agricultural Experiment Station (1899), reports on the disease as follows: "If the attack is severe the new growth will be destroyed and the older growth will be considerably injured. In the case of a very severe attack the fruit will be rendered worthless, and the foliage will be nearly or entirely killed during July. As a result, no fruit-buds are set for the next year's crop, and the bushes are so badly weakened that they may suffer from winter injury. In commercial plantations, where little or no spraying is done, the crop of fruit is destroyed and the bushes practically ruined by this disease."

Prof. S. A. Beach, in Bulletin No. 114 of the same Experiment station, sums up the matter as follows: "The one great hindrance

to the cultivation of European gooseberries in this country is their susceptibility to attacks of the American Gooseberry-mildew. From the standpoint of the American fruit-grower gooseberries fall into two classes, those which suffer from the mildew and those which do not. The former class includes all European varieties and their American-grown seedlings, or, in other words, all varieties of the species *Ribes Grossularia*, L. The latter class includes the cultivated varieties of the native American species *oxyacanthoides*, L., and *cynosbati*, L., and some hybrids between them and the European species. On account of their liability to serious attacks of mildew, European gooseberries should not be planted for commercial purposes, except by those who are prepared to contend with that disease." Prof. S. A. Beach, who has published a handbook which gives a full account of the cultivation of gooseberries in the United States, is recognised in America as one of the chief authorities on the subject. In answer to my inquiry, Prof. Beach has supplied me with the following additional information: "I do not think anyone has collected data from which any satisfactory estimate might be made of the economic loss occasioned by the American Gooseberry-mildew in the United States. In general it may be said that because of the ravages of this disease varieties of the European gooseberry are not grown to any considerable extent in this country. Those who have tried them have generally abandoned the attempt. The experiments conducted by the New York Agricultural Experiment Station have demonstrated that the disease may generally be kept under control by thorough spraying, but this spraying entails an expense which is liable to consume a large share of the profits of the business, if not all of them. When the risks of failure from sun scald and mildew are taken into consideration, those who grow gooseberries usually prefer American varieties like Downing, Josselyn, etc., for commercial plantations. It is safe to say that were it not for the danger of loss from attacks of this Gooseberry-mildew, the European varieties would be largely planted in this country in commercial plantations, but because of the ravages of this disease efforts to grow them on a commercial scale are usually soon abandoned."

In Bulletin No. 39 of the Idaho Agricultural Experiment Station, lately issued, Prof. L. F. Henderson writes: "Eight or ten rows of gooseberries were planted on our station ground several years ago,

and I am perfectly safe in saying that from that time till 1903 not a single crop of fruit was gathered, owing to the presence of the American Gooseberry-mildew."

A detailed account of the serious injury which the American Gooseberry-mildew has inflicted in Ireland, both to the crop and bushes, will be found in my papers in the *Journal of the Royal Horticultural Society*,* in which the experience of a number of growers with regard to the development of the disease in Ireland during the last six years is given. It has been found that when once this mildew makes its appearance, it spreads rapidly, and attacks the bushes with increased virulence each year. In many cases the whole, or the greater part, of the crop has been ruined, and the bushes have become so infested that they have had to be destroyed.

The following reports by scientists relate to the injury caused by the mildew since its appearance on the Continent:—Russia, Michailowskoje: "Not only was all the fruit completely destroyed, but the fungus occurred also on the young shoots."—Port Kunda, Esthonia: "The fungus destroyed the whole crop of gooseberries." Riga: "The disease has been noticed here on almost all the varieties of gooseberries, viz., on smooth, hairy, yellow, and green-berried varieties. This year (1904) all the gooseberries in the neighbourhood of Riga have been attacked and destroyed." Germany: Prof. Aderhold records that in the district of Posen the entire loss of the gooseberry crop resulted in some instances. Denmark: Prof. Rostrup states that in the two localities where the fungus was first observed, practically not a single berry remained free from the disease.

With regard to the injury caused in Sweden, and the measures taken by the Swedish Government against the disease, the following extract may be given from a recent article by Prof. J. Eriksson:

"At the beginning of the outbreaks it was hoped that the mildew would not be able to thrive in Europe, or at any rate would not show the same destructive power as it has done in America. Alas! in all the European countries where the mildew has managed to make its appearance not only has it established itself firmly, reappearing year after year, but it has annually increased its area

*Vol. XXV. (1900); XXVI., XXVII. (1902); XXIX. (1904); XXXI. (1907).

and the virulence of its attacks. Further, its vitality, as shown by its powers of infection, has even exceeded that shown in America, since in several places in Europe the fungus has attacked species of plants which in America have been either spared entirely or infected only in exceptional cases—viz., the distinct species *Ribes aureum* (used in raising standard gooseberries), the red and the black currant, and apparently also the raspberry.

“The case of one of the earliest infected areas in Sweden—viz., the little town of Falsterbo, in the southernmost part of the kingdom—may be taken to illustrate the destructive powers of the pest :— (1) The mildew was first observed at this spot three years ago on gooseberry bushes imported from Denmark ; (2) since that time the disease has spread annually with such increasing virulence that last autumn not a single healthy gooseberry bush was to be found in the whole vicinity ; (3) neither spraying with fungicides, nor cutting off the infected shoots, nor cutting off the branches down to the very ground, stopped the spread of the disease ; (4) healthy bushes planted last spring became infected by about the end of June ; (5) the local gooseberry-growers, unable to stop the epidemic, found themselves compelled to appeal to the Government authorities for the destruction by fire of the whole of the infected gooseberry plantations and for compensation for the same from the public funds ; (6) on November 12th last about 2,000 bushes, worth about 1,400 crowns, were grubbed up and burnt under official supervision. It is intended that the planting of gooseberries shall cease for two years, when it is hoped that the cultivation may be renewed with the planting of fresh healthy stock.

“In Sweden the Government has in a very praiseworthy manner dealt energetically with the matter by carrying out promptly the following measures :—

“On September 27th, 1905, immediately after the discovery of the disease in Sweden, a Royal prohibition was issued against the importation of gooseberry plants and their fruit, and at the same time 3,000 crowns were set apart from the public funds for use in compensating growers for losses incurred. The Royal Agricultural Academy distributed an illustrated leaflet on the disease throughout the country, and communications were sent to the agricultural societies in the various districts directing them to be on their guard

against the new pest. On July 17th, 1906, the Government assigned 1,000 crowns for the purpose of organising a general campaign against the disease. Appeals to the public were made in the newspapers, leaflets were distributed, the infected districts were visited by the officials of the experimental station, and so forth. On September 10th, 1906, another Royal prohibition was issued forbidding the transportation of gooseberry plants, or any parts of them (with the exception of the berries) within the limits of the kingdom.

"Since then I have communicated with all the agricultural societies in Sweden on the subject of a proposed compulsory law, similar to that now in force against certain diseases of animals. According to this law, every grower whose gooseberry plants became infected by the American Gooseberry-mildew would be required to destroy immediately all such plants, and would be paid by the Government a sum up to half their value as compensation. In connection with this proposal, the Government will be asked to set aside a sum of 30,000 crowns for compensation for losses likely to occur. One of the agricultural societies has already petitioned the Government in favour of the passing of such a law, to come into force in March, 1907."

The same legislative steps against the disease have recently been taken in Finland.

It might have been thought that our agricultural Authorities, in view of the disastrous experiences of other countries with regard to the American Gooseberry-mildew, would have been ready to take prompt and decisive action against such a destructive disease, on receiving information of the fact of its introduction into this country. Unfortunately the efforts to induce the Board of Agriculture to take the necessary legislative measures to eradicate the disease in Ireland, to prevent it reaching England, and since it has now appeared in this country, to stamp it out before it spreads, encountered at first the greatest apathy, and even now after ceaseless agitation have proved only partially successful.

It may be well here to review somewhat in detail the actual course of events which has followed the discovery of the present disease in Ireland and in England, since the facts form a striking object lesson of the systematic neglect by the agricultural

Authorities in this country of scientific matters of the greatest economic importance to fruit-growers.

In 1900, in recording the fact of the appearance of the American Gooseberry-mildew in a garden in County Antrim, Ireland—the first appearance of the fungus in Europe,—I wrote* “This new Gooseberry disease, which has just appeared in Ireland, is capable of causing the most serious damage on a large scale. It is therefore a matter of economic importance that steps should be taken to stamp out, if possible, the disease at once.”

In 1902, when pointing out that the disease had appeared in several fresh localities in Ireland, and had been reported from two places in Russia, I wrote†; “It may be well here to draw attention to the serious economic danger with which European fruit-farmers will be confronted if the American Gooseberry-mildew is allowed to establish itself in Europe. In every case where the disease has appeared it has assumed a serious character, and tends to recur annually in increasing severity; and there is no doubt that gooseberry growers in Europe are now face to face with a dangerous enemy.”

In 1905 I recorded the continued increase of the disease, pointing out that it was now established in Ireland in nine localities in six counties, and that it was now reported from Russia in ten districts, and from Denmark in two localities. I wrote‡ “At the risk of repetition I cannot refrain from urging here that vigorous steps should be taken at once by the authorities to stamp out this disease in Ireland. Undoubtedly the first step that should be taken with the object of eradicating the disease in Ireland is the examination, by an expert, of the nurseries in the affected districts, as the existence of any such nursery gardens containing affected stock must serve as permanent and prolific centres of infection. There is no reason why, if the destruction of the infected stock in nurseries and the burning of diseased bushes in private gardens are carried out, the disease should not be entirely extirpated from Ireland. But the possibility of the complete eradication of the disease diminishes

* See *Journal of the Royal Horticultural Society*, XXV., 139 (1900).

† *l.c.*, xxvi., 778, and xxvii., 596 (1902).

‡ See *Journal of the Royal Horticultural Society*, XXIX., 102 (1905).

as each year passes, bringing with it the establishment of the mildew in fresh localities. Already the list of affected areas has grown dangerously long, and the agricultural authorities will incur a grave responsibility if they neglect to take prompt and energetic measures to stamp out the disease. English gooseberry-growers should demand of the Authorities the prohibition of uncontrolled importation of Gooseberry bushes into England or Ireland, and they should demand further that every means be taken to stamp out the disease in Ireland."

In 1906 I wrote* "It is quite clear that the danger is now imminent. This disease was unknown in Europe until 1900, when it was found in three gardens in two counties in Ireland, to which country it had been imported on diseased stock. At the present time the disease is flourishing in Ireland in hundreds of gardens in fourteen counties, and is still existing in the very same gardens from which it was reported in 1900. So far England is free, but if the present conditions are allowed to continue, it is practically certain that the appearance of the disease in England is merely a matter of time."

On November 10th, 1906, I reported† the discovery of the American Gooseberry-mildew in an English nursery, on the young wood of a number of standard gooseberries on *Ribes aureum* stocks. These standards had been recently imported from the Continent. The owner of the nursery, on being informed of the outbreak, and of the serious nature of the disease, at once volunteered to burn all the standards, and promised, should the disease appear next spring on other gooseberry plants, to carry out the strictest possible preventive measures.

It was clear that we were now just at the beginning of the long-threatened outbreak of the disease in this country.

In consequence of a Report which I laid before the National Fruit-growers' Federation, the Council decided to obtain an interview with the President of the Board of Agriculture. The most that the delegates at this interview were able to obtain was a promise that if a Private Bill dealing with the disease were brought in by a

* See *Gardeners' Chronicle*, Nov. 3rd, 1906.

† L. c. Nov. 10th, 1906.

Member of Parliament it "would be regarded sympathetically by the Board of Agriculture." It need only be pointed out here that, having regard to the course of Parliamentary procedure, there was no possibility of such a Private Bill becoming law within the space of time during which legislative measures could be efficacious in stopping the spread of the disease.

At the instigation of Wye College, Questions were asked in the House of Commons and in the House of Lords, calling attention to the danger now threatening one of our most important fruits, and to the need for immediate steps to be taken to prevent the further importation of diseased gooseberry plants. The Board of Agriculture on November 15th gave the following reply: "The Board have no power to prohibit the importation or to order the destruction of diseased stocks, and it is not practicable to introduce legislation on the subject during the present session. A leaflet on the subject has been in circulation for some years, and several thousand copies have been distributed during the present year. The Board are now in communication with the Customs with a view of obtaining the necessary information to enable them to warn importers against purchasing Gooseberry bushes from countries where the disease is prevalent."

To anyone conversant with the facts of the case, it was quite clear that if only the amount of attention here indicated was to be given to the matter, this new disease must inevitably spread through England as it has spread through Ireland and certain Continental countries. On the above answer I commented as follows:*

"As to the Board having no power at present to stop this importation of diseased stock, it is of course for this very reason that immediate legislation is necessary.

"Then as to the leaflet on the subject which 'has been in circulation for some years,' and of which 'several thousand copies have been distributed during the present year.' What do we find? In a leaflet devoted to the harmless European Gooseberry-mildew,† a short paragraph, inserted in 1901, in which the bare statement is made that 'the American Gooseberry-mildew was met with in con-

* See *Gardeners' Chronicle*, December 1st, 1906.

† This is a closely-allied mildew, not uncommon in England, which affects only the leaves and is not a dangerous disease (see above, p. 278).

siderable abundance in Co. Antrim, Ireland, during the summer of 1900.' No word is mentioned that the disease is a highly infectious and recently-introduced one, nor any warning given as to the sources of danger. The case would be similar if we supposed that a highly-infectious and epidemic disease of animals, recently introduced into this country, had been dealt with by a short paragraph in a leaflet on some comparatively harmless disease. It is deplorable if the Board think that any good whatever can be done by the issue and distribution of such a leaflet.

"As regards the warning of importers 'against purchasing gooseberry bushes from countries where the disease is prevalent,' such a course is utterly useless. In the first place, the disease is spreading so rapidly on the Continent that it is not safe to say that any country there is free. Secondly, with the system of interchange of stock that is current among Continental firms of nurserymen, it is impossible to trace the *original* source of imported plants. To take a case in point. The standard gooseberries on which I found the American Gooseberry-mildew in an English nursery were imported from a firm in France. Now the disease has not been reported as occurring in France. Either the disease does occur there, however, or the standards were originally obtained from a nursery in some country, such as Germany, where the disease is known to occur."

It was obvious that neither the seriousness nor the imminence of the danger was yet realised by the Board of Agriculture, and also that there was a total unpreparedness for dealing with such matters.

With the object of warning growers of the new pest, and in order to get the Fruit-growers' Associations of this country to pass resolutions urging on the Board of Agriculture the necessity of their taking immediate and energetic steps to eradicate it, I commenced giving a series of free lectures in the various fruit-growing centres. As a result the most important of the Fruit-growers' Associations and Farmers' Clubs of this country have sent in to the President of the Board of Agriculture resolutions asking for the employment of legislative measures against the disease. The Trade has also petitioned to the same effect.

When in Worcestershire, I received information after one of my lectures which led me to inspect some plantations in that

county, and I there discovered an extensive outbreak of the American Gooseberry-mildew on some twenty acres of gooseberry-bushes. The bushes, over one half-acre, were so badly infested that the tips of practically all the young shoots were diseased, being coated over for a distance of several inches with the brown scurf-like spawn (*mycelium*) of the fungus, bearing the conceptacles containing the winter-spores (see Plate I.). In some parts of these plantations the mildew attacked the berries so severely last season that they had to be picked over before being marketed. A second infected area was soon discovered near Evesham. Here a certain nurseryman had received from a nursery a few bushes as a sample of a lot of 6,000 bushes which were offered for sale. In the ordinary way these 6,000 bushes would have been immediately consigned to a purchaser in Essex, but the attention of the nurseryman having been directed, through the lecture which I had recently given at Evesham, to the necessity of closely scrutinising all bushes before planting them, he was led to suspect the condition of these sample bushes, and sent them to Wye College for inspection, when I found them to be very badly infested with the American Gooseberry-mildew. The consignment to Essex was stopped; but it is unfortunately a fact that some thousands of bushes from this nursery had already been sent out to various purchasers.

After I had left the district, these cases were reported to the Worcestershire County Council, and Mr. G. Massee, of Kew, was sent to investigate the outbreaks. Up to this time, as the result of the emphatic warnings I had given of the extremely serious nature of the disease, all growers had been making earnest endeavours to discover and stamp out the disease, and in view of the fact that it was a new disease to England, to track the source by which it was being introduced into the country. On Mr. Massee reaching the infected district, the following statements were at once published by him in the Press and circulated among the growers—these statements being given the widest circulation as being the scientific opinions of the Board of Agriculture's expert sent down to report on the disease :* “ There was no need for the slightest alarm ; the climatic conditions in Worcestershire are against the development of the

* See, for example, *The Times*, December 8th, 1906, and the *Evesham Standard*, December 8th, 1906.

disease ; in Ireland the conditions favoured its growth, but the injury there had been exaggerated ; the disease would not necessarily reach the fruit ; the owner of one plantation said the disease had been there thirty years ; and it seemed clear that the disease was indigenous to the county and not introduced, so that legislation to prevent its importation was unnecessary ; the statement that it was impossible to grow [European] gooseberries in America was a mere figure of speech."

Knowing that the whole weight of scientific opinion was against these statements of Mr. Massee's, and having regard to the fact that the matter, especially as it occurred at the critical time of the first outbreak of the disease in England, was of considerable economic importance, I immediately sent a letter to the Board of Agriculture and to the Press† asking for scientific arbitration of the points at issue. I wrote as follows: " I wish to make the following necessarily brief replies to Mr. Massee's statements:—(1) The climatic conditions obtaining in Worcestershire are certainly no less favourable to the spread of the disease there than are those of some of the various countries in Europe, where the disease is now rampant. (2) My articles in the *Journal of the Royal Horticultural Society*, Vols. xxv., xxvi., xxvii., and xxix., contain the reports—given in their entirety—from all the growers in Ireland with whom I could get into correspondence, and give a detailed account of the annual damage done to the bushes and the crop. (3) Mr. Massee, in his short visit, did not apparently learn that in a certain plantation in Worcestershire the fruit, last year, was so affected by the present disease that it had to be picked over before being marketed. (4) I have mentioned in the papers referred to above certain facts which I obtained that point to the disease having been brought into Ireland on imported stock. Further, in the case of the infected gooseberry standards found in an English nursery, the disease occurred only on the imported plants ; also, at Evesham, I obtained information that bushes have been imported from the Continent into this district. Prof. A. de Jacewski has published facts which show that there is every reason to believe that the disease in Russia was imported from America ; and Prof J. Eriksson, the most eminent

† See *Gardeners' Chronicle*, December 15th, 1906 ; *The Times*, December 28th, 1906 ; *Nature*, January 10th, 1907.

economic mycologist in Europe, in his recent article in the *Zeitschr. f. Pflanzenkrankh.*, Bd. xvi., traces the spread of the disease in Europe to three distinct sources. Mr. Massee must be well aware of these scientific opinions, yet gives credence at once to the statement of an unscientific person—the manager of the nursery—that the disease ‘had been there thirty years,’ and publicly states his opinion that the disease is indigenous to the country, and that legislation to prevent its importation is unnecessary. (5) The statements which I have made that the cultivation on a commercial scale of the European gooseberry in America has been rendered impossible by the susceptibility of the plant to this disease are based on the facts given to the Year Book of the Department of Agriculture (United States) for 1899, in the Report of the Commissioners of Agriculture for 1877 (Washington), in Bulletins 114 and 161 of the New York Agricultural Experimental Station, and on information supplied to me by Prof. S. A. Beach, one of the chief authorities in America on the cultivation of gooseberries.

“This is not the place to bring forward further scientific facts, which show the dangerous character of the present disease, and the need for immediate legislative action to prevent more diseased stock coming into the country. One serious misstatement made by Mr. Massee on the manner in which the disease could be imported on bushes I corrected in the *Gardeners’ Chronicle* in January last; but this has not prevented Mr. Massee from repeating it in a chapter on ‘Legislation and Disease’ in his recently published book.

“Since I believe that the most energetic and consistent action, assisted by careful expert advice, is now required from the Board of Agriculture to save gooseberry growers from great losses, I ask that the Board shall investigate the value of the opinions of its scientific adviser on the present disease by submitting the question to some independent and competent scientific authority in this country or abroad. The Board should then state publicly the decision arrived at, and if it is decided that the danger is as serious as I believe it to be, the Board should at once send an official to the affected areas in Worcestershire to repair, as far as possible, the mischief caused by the statements which Mr. Massee has circulated in the district to the effect that the danger has been exaggerated, that no legislation is necessary, and that the disease has not been introduced through

the purchase of foreign gooseberry bushes. I ask that the investigation shall be carried out immediately, since it is useless to expect growers to carry out sufficiently drastic measures in face of the statements which will be widely circulated as the opinions of the scientific adviser of the Board of Agriculture."

To any one acquainted with the facts,—now recorded from a number of Continental countries—which show how rapidly the present disease spreads when once it is allowed to establish itself in a number of localities in any new country, it was perfectly obvious that unless the Board of Agriculture chose to exert itself to acquire at once *legislative* powers to stop all further importation of diseased gooseberry plants, and to stamp out the disease in any reported infected area, the possibility of eradicating or even controlling this mildew would soon pass away. It was then in the highest degree important to know if the Board intended to deal with the American Gooseberry-mildew as an epidemic disease recently imported into this country.

Unfortunately, the Board of Agriculture showed itself still inclined to temporise in the matter, as was apparent from the answers given to Questions asked in the House of Commons. On December 13th, Mr. Laurence Hardy asked: "Whether in view of the danger to the fruit-growers of Great Britain in consequence of the outbreaks of American Gooseberry-mildew in this country, a danger admitted by the Board in the circular just issued by the department, the honourable member for South Somerset, as representing the President of the Board of Agriculture, will undertake at the earliest possible date to introduce legislation giving power to the Board, both to prohibit the importation of gooseberry bushes into Great Britain, and also to deal effectively within the country with infected stocks and insect pests, on the lines of The Destructive Insects Act, 1877." The same day Mr. H. Belloc asked a similar question in the House: "Whether, in view of the fact that extensive outbreaks of a most destructive fungus disease of gooseberries—viz., the American Gooseberry-mildew, have now occurred in Worcestershire, and that the Board of Agriculture have at present no powers to deal with the prohibition or control of the importation of diseased gooseberry bushes (on which the disease has been introduced into this country), the Government will introduce this

Session a short amending Act to the Destructive Insects Act, 1877, in order to give the Board the necessary legislative powers to deal with the disease.' To both Questions the same reply was given by the Government: 'Full inquiry is being made as to the necessity and practicability of legislation in the direction suggested by the hon. member, but until we are in possession of further information as to the characteristics and past history of the disease, and the nature and extent of the trade with which it is proposed to deal, it is not possible for us to enter into any definite undertaking on the subject. We fully appreciate, however, the importance of taking any action which may be decided upon as speedily as possible.' I commented* as follows on this answer:—

"That is to say, the Board are not yet prepared to obtain the necessary legislative powers to deal with the danger at its source. Let it be remembered that the Board have been confronted for six years (since 1900) with the actual existence and the spread of the disease in Ireland, and that in my seven articles on the disease in 1900,† 1902,‡ 1905,§ and 1906,|| emphatic warnings have been given of the great danger of allowing the disease to spread over Ireland, and the fact pointed out that unless legislative steps were taken, the appearance of the disease in England was merely a matter of time. In 1901 the Board inserted an utterly inadequate paragraph on the disease in their leaflet on the comparatively harmless European Gooseberry-mildew; during 1906, after the disease had spread over the eastern half of Ireland, the Board (in Ireland) instructed horticultural inspectors to warn growers of the disease and issued a leaflet giving the advice that the safest step is to uproot and burn the attacked bush; and now, at the end of 1906, when extensive outbreaks of the disease have been discovered in England in the middle of one of the most important fruit districts, the Board announce that 'until we are in possession of further information as to the characteristics and past history of the disease, it is not possible for us to enter into any definite undertaking on the subject'

* *The Fruit-grower*, December 27th, 1906.

† *Journ. Roy. Hort. Soc.*, Vol. xxv. (1900).

‡ *Loc. cit.*, Vols. xxvi. and xxvii. (1902).

§ *Loc. cit.*, Vol. xxix. (1905), and *Gardeners' Chronicle*, October 28th, 1905.
Gardeners' Chronicle, January 27th and November 3rd, 1906.

[of legislation], and are pursuing the course of merely giving warnings. This, too, it should be remembered, is in face of the following facts: (1) The present disease is one in which the characteristics and life-history of the fungus have been well worked out scientifically; (2) there is a voluminous literature giving the methods, legislative and otherwise, of State control of the disease in other countries; (3) the disease has actually been observed in England on recently-imported standard gooseberries, and information obtained that importation of gooseberry bushes has also occurred, and, especially during the present winter, will most probably still occur.

"In Sweden, within a few months of the first appearance of the disease, the Government, acting on the advice of Prof. J. Eriksson, recognised that a new disease was threatening the cultivation of the gooseberry, and legislated to prohibit all further importation of gooseberry bushes. Our Government, after being confronted with the disease for six years, states it is waiting 'for further information as to the characteristics and past history of the disease,' and *The Times* and the Press generally are circulating the statements of Mr. Massee, as the expert of the Board, that the disease is not an introduced one, that it is unable to flourish in the climate of Worcestershire, and that no legislation is necessary."

With regard to the official circular issued at this time by the Board on the subject of dealing with the American Gooseberry-mildew, I wrote as follows:—"The instructions given are open to adverse criticism on many points, the most important being these:

"Growers are told to use Bordeaux mixture 'when the disease is dormant'—*i.e.*, as a winter wash—with the object of destroying any external mycelium or adhering spores that may be present.' *As a matter of fact there is in winter no living mycelium to be killed, nor are there naked spores anywhere adhering to the plant;* and it is not probable that the Bordeaux mixture would penetrate to the winter-spores inside any fruit-bodies (*perithecia*) which might be present. So growers who spray as thus directed will literally waste their money.

"The circular concludes: 'The Board believe that the American Gooseberry-mildew has not spread very far as yet, and that it depends very largely on the action of the fruit-growers, nurserymen and market-gardeners whether its further development can be

prevented.' To a much larger extent, however, it depends upon the Government. Unless the Government will legislate at once to keep out more diseased gooseberry bushes and standards it will in all probability be as impossible for growers to stop this most infectious disease from reaching their gooseberry plantations as it would be for farmers to stop the spread of foot-and-mouth disease if the Government refused legislation to prohibit the importation of cattle. If the Board of Agriculture had the interests of fruit-growers at heart, it would surely have recognised that in face of the great and increasing scarcity of gooseberry bushes in this country, and the consequent temptation to import from the Continent, the policy of temporising at the present time is likely to be fatal, and that by immediate legislation alone is it possible to prevent the establishment of so large a number of infected areas in this country as to make remedial measures no longer possible. Having regard to what has taken place in strictly parallel cases, it may be predicted that if once the American Gooseberry-mildew becomes firmly established in England, it will never be completely eradicated.

"Lastly, it is to be noted that in this circular sent out by the Board, perhaps the most important fact connected with the disease has been omitted. It is not stated that this disease is native to America; that it is believed by the best scientific authorities to have been introduced into Europe about 1900; and that in such a case as this—as was shown so clearly in the Forties by the introduction and spread of the vine-mildew (*Oidium Tuckeri*) and the potato blight (*Phytophthora infestans*), the attacks of the fungus in Europe may be expected to be of exceptional virulence. It is somewhat quaintly stated by the Board that 'the disease is termed American owing to the extensive damage it has done in America'—that is as though one were to say of the Americans 'they are termed Americans on account of the great amount of work they have done in America.' The present mildew is of course called the American Gooseberry-mildew, because its native home is America."

The next event was an announcement made by Mr. G. Massee (at the close of a lecture I gave to the Royal Horticultural Society in London, on January 8th, 1907) to the effect that his visit to the infected areas in Worcestershire had been in no way connected with the Board of Agriculture. Concerning the circumstances of the

case, and the effect the actions of Mr. G. Massee and the Board of Agriculture had had, I wrote as follows * :—" I pass over without comment Mr. Massee's action in allowing, under the circumstances, the opinions which he published to be described as those of the Board's expert sent down to investigate the disease, or of not correcting the report at once. It will be remembered that both in *The Times* and in the *Evesham Standard* prominence was given to the statement that Mr. Massee had been sent down by the Board of Agriculture.

" Now with regard to the Board's action in the matter. Immediately after the publication of Mr. Massee's series of statements as those of the Board's expert, I sent to the Board a copy of my letter to the Press, in which I asked for scientific arbitration in view of the economic importance of the matter, since I believed that the whole weight of scientific opinion was against the statements which Mr. Massee had made. It was, as I pointed out to the Board, a matter of urgency, since the effect of Mr. Massee's statements, throwing, as they did, doubt both on the serious nature of the disease and on its foreign origin, could not but have the most injurious effect at the critical stage of the first outbreak of the disease in commercial plantations in England. The Board received definite notices from local growers, from, I believe, the Worcestershire County Council, and from myself, informing them that the circulation of Mr. Massee's opinions, which were naturally accepted as having the authority of the Board behind them, was having the effect of causing individual growers to relax their efforts to stamp out the disease. One grower, believing the statement to which Mr. Massee gave credence that the disease 'had existed thirty years in a plantation and had not affected the fruit,' has proposed planting out an acre of diseased stock from an affected nursery as a demonstration to those who doubt the 'fact.'

" The matter was left without explanation (although I was in correspondence with the Board) from December 8th until January 8th, on which day Mr. Massee publicly announced that his statements, circulated through the Press as those of the Board's expert, were in reality given in his private capacity. During the interval it was extremely difficult for me to lecture on the subject, and make

* *The Fruit-grower*, January 17th, 1907.

growers realise the serious nature of the danger. At Wisbech, where I gave a lecture in which I emphasised the destructive nature of the disease, as shown in Ireland and in America, and pointed out the fact that it was now being introduced into England, I was told at once by one of the audience that it was the opinion of the Board of Agriculture's expert that the injury it had done in Ireland and in America had been greatly exaggerated, that it had been in England for thirty years, that it could not flourish in this climate, etc. My request for arbitration could apparently have been answered at once by the Board stating the facts of the case; this would, I think, have been done, in common courtesy and straightforwardness, by any private individual.

"The future is more important. The Board have at last recognised the serious danger; they state in their recently issued Circular that 'the disease is of a very serious character, *and has rendered the culture of Gooseberries unprofitable and practically impossible wherever it has appeared.*' That is one important step in the right direction. The second important step will be taken when the Board recognise the fact that the mildew is a new epidemic disease lately introduced into Europe, and now for the first time beginning to destroy the gooseberry in England, and when they impress on growers the necessity for treating it as such by immediately stamping it out at the cost of the burning of diseased bushes. Let them make growers realise that hitherto they have had no experience of this most destructive disease, and that unless the outbreaks are dealt with in the most drastic way during the next few years, the same wholesale devastation may result as when the closely-allied vine-mildew was introduced into Europe in the same way from America. So long as the Board allow doubt to remain on this point some growers will certainly be inclined merely to watch the disease or to experiment with it, and then the disease will rapidly increase in England."

At this meeting in London, Mr. Massee made a number of statements all calculated to have the worst possible effect on the efforts which were beginning to be made by growers to stamp out the disease in this country. Mr. Massee's remarks were reported as follows in the *Gardeners' Chronicle* of January 12th, 1907:—

“Mr. Massee stated that the dominant feature of Mr. Salmon’s argument in favour of legislation was a quotation from an American expert, to the effect that English gooseberries could not be grown on a commercial scale in America, owing to mildew. This quotation was quite correct, but Mr. Salmon omitted to mention, in his many communications to the Press, that it was made twenty years ago at a period before spraying and preventive methods against diseases were evolved. Since that period equally emphatic statements have repeatedly appeared in official American publications to the effect that, owing to the efficacy of sprays, English gooseberries were again in cultivation, and it was doubtful whether American varieties could maintain their supremacy. Such statements appear to have been overlooked by Mr. Salmon, as they are absent from his essays. Under the circumstances, Mr. Salmon’s leading text must be considered as of historical interest only, and without meaning at the present day. Mr. Salmon’s opinion that the disease is new to Europe, and introduced from America, is not supported by facts. The fungus was known in Ireland for some time before its identity was established and its presence announced in the *Gardeners’ Chronicle*, August 25th, 1900, p. 143, fig. 39. Some European experts consider that the mildew is indigenous in Russia. It is a well-known fact that a given fungus may be present in a country for any length of time before it decides to become an injurious parasite, and, again, a given fungus may prove very injurious in one country and harmless in another. Special weather conditions often furnish the necessary stimulus that determines the commencement of a fungus on a parasitic career; such conditions were experienced in this country last year. Some gooseberry growers have expressed the opinion that they have known the mildew in this country for many years. These may not be convincing, but they have not been proved to be wrong.

‘The one important point on which all are agreed, is the fact that the mildew is now established in this country. In Worcestershire, where it is fairly abundant, there is not the remotest evidence in support of the theory that it was introduced from the Continent.

“In the absence of any evidence as to the introduction of mildew on imported bushes, at the moment of importation, and remem-

bering the fact that so few gooseberry bushes are imported under any circumstances, legislation may be considered as outside the sphere of usefulness in preventing the spread of the disease.

"Finally," said Mr. Massee, "it must be noted that from Mr. Salmon's own statements, the mildew is most abundant in those countries where legislation against diseases is most stringent."

In the next week's issue of the *Gardeners' Chronicle*, I replied as follows:—

"(1) Mr. Massee stated that since spraying has come into vogue in the States the mildew has been rendered comparatively harmless; my statement that the mildew practically prevents the commercial cultivation of our Gooseberry in the States Mr. Massee characterised as 'one of historical interest only, and without meaning at the present day.' I need only state that I have received a letter, *written a few weeks ago*, from Prof. B. T. Galloway, Chief of the Bureau of Plant Industry, U.S. Dept. of Agriculture, with the following information: 'Only a few varieties of European gooseberries are grown in this country commercially, and these have never been important.' Thus we see that, notwithstanding the thorough spraying which the American grower employs, it is still only in a few localities that it has been found possible to grow our gooseberry, and even this applies only to two or three varieties; elsewhere the mildew entirely prohibits their profitable cultivation. Further, there is now the established fact—and Mr. Massee knew this—that the fungicide (liver of sulphur) which has proved to be the most efficacious in the States, is being found to be comparatively useless in European countries. It is expressly stated by Prof. Eriksson, as being the experience of growers in Sweden who have tried spraying—and I am told the same is the case in Ireland—that this fungicide fails when applied to our tenderer European varieties; in the first place, it may cause injury to the leaves and fruit; in the second, it fails to destroy the fungus because of the increased virulence of the latter, due to its reaching a new Continent.

"(2) Mr. Massee said that my statement that the disease is new to Europe, and introduced from America, is not supported by facts. I rely on the evidence published by Prof. Eriksson and Prof. A. de Jacewski, and on the information I have myself col-

lected. Mr. Massee states that 'some European experts consider that the mildew is indigenous in Russia.' Here Mr. Massee is relying on the early opinion held by Prof. Jaczewski: and, to use his own words, Mr. Massee's statement 'must be considered as of historical interest only, and without meaning at the present day.' If Mr. Massee will turn to the Report laid before the Seventh International Congress of Agriculture (Rome, vol. ii. p. 442 [1904]) he will see that Prof. A. de Jaczewski—the scientific adviser to the Russian Government, and the only mycologist who has investigated the disease in Russia—has published here the latest evidence. This evidence has caused Prof. Jaczewski to alter his previous opinion, and he now states that he is convinced that the disease has been brought into Russia on gooseberry plants imported from America. I adhere to my statement that this disease was unknown in Europe until about 1900, when it was imported from America, and that it must be treated as a dangerous, highly infectious disease, *of which English growers have hitherto had no experience.*

" (3) In December Mr. Massee stated in the *Evesham Standard* that the mildew 'can only thrive *in damp climates.*' Now, in January, Mr. Massee states that it requires 'special weather conditions such as were experienced in this country last year,' *i.e., very dry weather.* As a matter of fact, from the detailed reports sent to me by gardeners in Ireland, which I have published,* describing the weather conditions under which the continued spread of the disease has taken place from 1900 to 1906, and having regard to the rainfall in the fruit-growing districts in England, there is not the slightest reason to expect that the climate of Ireland and of England will prevent the disease from assuming that epidemic proportion which it has already assumed in the dry regions of Sweden and of Prussia.

" Finally, with regard to legislation. I have seen the mildew on recently-imported standard gooseberries in an English nursery, where the surrounding plots of gooseberry bushes were healthy. Again, I have ascertained the fact that in the district of Worcestershire, where I discovered the disease in commercial plantations, bushes had been imported from the Continent. The disease is steadily

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increasing its area on the Continent. I can vouch for the fact that in Kent, and also in other fruit-growing counties, a number of growers are now in the habit of importing gooseberry bushes direct from the Continent. Is it not obvious that a mere warning as to the danger of importing at the present time would either not reach, or would be disregarded by, many importers, and that prompt legislation temporarily forbidding importation can alone save the creation of fresh-infected areas in this country ?

“ Mr. Massee misses the point curiously ; he says that the disease, from my own statements, ‘ is most abundant in those countries where legislation against diseases is most stringent,’ that is, in the States. When we remember the fact that the American Gooseberry-mildew is a *native* of the United States, occurring in practically all the States on no fewer than twelve wild native species of *Ribes*, this is not in the least surprising. And it does not affect in the slightest my statement that the disease could be kept out of England by legislation.”

In the *Journal of Horticulture* for January 17th, 1907, I wrote :

“ Mr. Massee stated, after my lecture at the Royal Horticultural Society last week, that the disease was known ‘ here and there ’ in England, that there was reason to believe it was indigenous, and that at any rate it was too late to talk of keeping it out by legislation. But when I asked Mr. Massee to tell the meeting of any place where it existed except in Worcestershire, he remained silent. We know that Mr. Massee has given credence to the statement of a grower in Worcestershire that ‘ the disease had been there thirty years, and had not affected the fruit.’ Now, I have investigated this case, and it seems to me certain that what the grower saw in previous years was not the mildew, *but the injury produced by “green fly” on the tips of the young shoots.* I have myself seen cases where severe attacks of “green fly” have produced a uniform browning of the tip of the young shoot, simulating the mildewed tip (covered by the brown scurfy spawn) so closely that I have had to examine it closely in order to make sure. It is obvious, therefore, that before we can accept the evidence of any grower that he has had this disease thirty years we must know that he is able to distinguish between these two things. What are the facts of the present case ? This grower first maintained that it was not

the American Gooseberry-mildew at all ; he then stated, according to a local paper, that ' the mildewy appearance of the shoots was due to the fact that in the summer the shoots were attacked by green fly,' and that it ' had been there thirty years and not affected the fruit.' Finally, I am told that another person working on the same place holds the opinion that the mildewed appearance seen this year on the bushes was *not* the same as the appearance noted in previous years. The mere statement, too, of the grower that for thirty years it had been present *and not touched the fruit*, would be by itself enough, considering what we know of the present disease, to dismiss this case as not affording any reliable evidence.

" The second case, apparently, on which Mr. Massee relies, is that published last week by Mr. Abbey in the *Journal of Horticulture*. Mr. Abbey states that the mildew ' has been known in this country for at least fifty years.' Mr. Abbey, on my writing to him for full details, gave me the following information. As I have permission from him to do so, I will publish the letter, so that all the evidence may be known. Mr. Abbey writes : ' I very much regret to say that I have no data that would enable me to give the information you require as to the previous occurrence of the American mildew in England, inasmuch as the occurrences were not scientifically investigated until, I believe, 1901, and then in specimens received from Ireland, and I think the first time it was found in fruit and referable to its proper place. In this sense only can the disease be regarded as *new* to the British Islands, for from time to time a few isolated and very distant cases of mildew attacking the berries have occurred within the last half of the nineteenth century, and from what I could gather from an old gardener extending in experience before 1800 down to 1850, the said mildew occurred occasionally, sometimes, but very rarely, attacking the berries and young wood.'

" I have not the pleasure of knowing Mr. Abbey personally, and I trust he will not be offended if I say that the above particulars do not supply sufficiently strong scientific evidence on which to support the statement that the mildew has been known in this country for fifty years.

" Mr. Massee stated last week that ' some growers have expressed the opinion that they have known the mildew in this

country for many years. They may not be convincing, but they have not been proved to be wrong.' It was the duty of Mr. Massee to have investigated the scientific evidence in each case instead of at once giving credence to the statements of growers."

The Press generally, putting reliance in the statements of Mr. Massee in consequence of his position as mycologist at Kew (which acts as scientific adviser to the Board of Agriculture), now began to circulate statements to the effect that the American Gooseberry-mildew was no new disease, just introduced into England, and seriously threatening the gooseberry crop, but that it had been known here for many years, and had done no extensive damage. Articles appeared* under such titles as "The Big Gooseberry Scare. Not Much Danger," throwing ridicule on the idea that any legislative measures should be taken against the disease, or indeed that any special exertions should be made by growers to stamp it out at once.

The statements made by Mr. Massee were seen at once to be unsupported by scientific evidence, when, as soon happened, properly qualified scientific men who had had the opportunity of studying the disease on the spot, came forward and published statements on the subject. These statements, as can be seen below, contradicted Mr. Massee on all points.

First, as regards Ireland, where this disease has been known now since 1900. Mr. Massee, never having visited Ireland and having had no experience of the disease, made the statement that "the injury in Ireland had been exaggerated." Dr. G. H. Pethybridge, Ph.D., B.Sc., now writes from Ireland † "Everyone who has come into working contact with the disease in this country admits the destructive nature of it. As to the actual money losses sustained up to the present, statistics enough have not yet sufficiently accumulated to permit the formation of a correct estimate, but it is no extreme view of the case to state that the losses have been in many cases most serious, and unless the disease is checked we are threatened with nothing less, practically, than the total loss of the profitable cultivation of the gooseberry as a bush fruit."

* See *Daily Graphic*, January 18th, 1907; *Land Agents' Record*, January 12th, 1907; also *The Field* about this date.

† *Irish Gardening*, April, 1907.

As regards Mr. Massee's statement that the disease is not one lately introduced into England, Prof. J. Eriksson, of Stockholm, perhaps the most eminent economic mycologist in Europe, has written * "Now, during the first years of the occurrence of this gooseberry disease in any new country there have always been people ready to suggest that this destructive pest was not an invader from some foreign country, but was really native to that country, though not discovered before. The very same tale was lately heard in Sweden, exactly as I read it now in Mr. Massee's report. However, on closer examination this assertion has always proved to be false. It is known that the disease has been introduced into Ireland, as well as into Russia, on gooseberry bushes imported from America about the year 1900, and I have myself ascertained that exactly the same was the case with regard to Denmark. The disease appears to have been distributed in Europe from these three centres. *Considering the facts we possess, the assertion that this mildew is indigenous in any European country is sure to be found to be unsupported by any scientific evidence whatever.*"

As regards Mr. Massee's statement that the disease, since the discovery of spraying with suitable fungicides, is able to be so easily controlled that it need no longer be feared, the following evidence recently supplied by Prof. S. A. Beach, of the Iowa State Agricultural College, U.S.A., and one of the highest authorities on the cultivation of the gooseberry in America, may be quoted†:—

"Numerous articles on the American Gooseberry-mildew which have been recently published show that the advent of this disease into the fruit-plantations of Great Britain and Ireland and of various portions of the Continent is rightly attracting the serious attention both of the fruit-growers and of economic plant pathologists. The evidence brought forward in the discussions above referred to goes to show that the disease is fully as virulent, if not more so, in England and on the Continent, as it is in America. This is greatly to be regretted, because the disease is capable of doing very serious damage to the gooseberry crop. . . . In spite of the fact that in the United States nurserymen have con-

* *The Times*, January 10th, 1907.

† *The Standard*, March 20th, 1907.

tinually offered for sale the choicest varieties of English and Continental gooseberries, and that efforts have been continually made to grow European gooseberries here both in an amateur way and commercially, the cultivation of these gooseberries has never become permanently established upon a safe commercial basis, because of the destruction caused by the American Gooseberry-mildew, *Sphaerotheca mors-uvae* (Schwein.) Berk. This is as true to-day as it was half a century ago.

“Under conditions which were most favourable to the development of the disease, it was found that it was extremely difficult to hold it under control by spraying, but under favourable cultural conditions, and in favourable seasons, the disease could be held well under control. In order to insure crops of fruit free from disease, as they must be if the business of gooseberry culture is to be placed on a reliable commercial basis, it has been found necessary to begin the treatment early in the season, and to spray at intervals of from seven to ten days, always making the applications very thoroughly. The expense of such treatment is so great as to discourage the commercial growers, as is evidenced by the fact that although it is nearly thirty years since a reliable remedy for the mildew was discovered, the English gooseberries are not being cultivated commercially to any considerable extent in America, and the varieties which appear in American markets are not European, but either natives or hybrids between native and European gooseberries.

“Since the American mildew is appearing in destructive form in various parts of Great Britain and Ireland, your gooseberry growers have just cause for alarm. From the record which this disease has made in America, it is evident that their interests can be safeguarded only by the adoption of the most vigorous measures for preventing the introduction of the mildew into uninfested localities, and for eradicating it, if possible, from those places where it has already appeared.”

In view of the misrepresentations made, it must be pointed out most emphatically that the disease has been imported into England from the Continent, and that this importation will continue unless legislative steps are taken to prevent it.

There is incontrovertible evidence on this point. In the English nursery, where I discovered the disease for the first time

in this country, only the recently-imported standard gooseberries were affected, the large stock of native gooseberry bushes being still free from it. In Worcestershire, where acres of diseased gooseberry bushes are now to be seen, I found on inquiry from the most reliable sources that an importation into the county of Continental bushes had been taking place regularly for several years back. Perhaps none of the irresponsible statements made by Mr. G. Massee has done greater mischief,—in obscuring the source of the danger and the absolute necessity of legislation to remove it,—than the following, made by him in London in January last*: “In Worcestershire, where the disease is fairly abundant, there is not the remotest evidence in support of the theory that it was introduced from the Continent.” The true facts of the case were soon afterwards published by Mr. J. Willis-Bund, the Chairman of the Worcestershire County Council, in the following report †:—“The American Gooseberry-mildew had been found in the following parishes in the south of the county, viz., Kempson, Charlton, Fladbury, Pinvin, Offenham, and Chadbury. As a result of investigations, it had been ascertained that there was a place in France which dealt largely in nursery stock sent over to this country. Those people sold in Evesham markets, and the whole of the gooseberries found to be diseased had been sold there, and had, he believed, come from these consignees. It showed the necessity for some very rigid protection of plants brought into the country.”

Meanwhile, at the instigation of Wye College, Questions continued to be asked in Parliament as to the intention of the Board of Agriculture to take steps against the disease. At length, on February 14th, 1907, Mr. A. C. Beck, M.P., received the answer that the Board “hoped to be in a position at an early date to introduce a Bill to confer further powers upon the Board and upon local authorities for dealing with pests destructive to agricultural or horticultural crops.” The Board were informed on March 18th by Col. Williams, M.P., of the fact that gooseberry bushes infested with the American Gooseberry-mildew were now actually on sale

* See the *Gardeners' Chronicle*, January 12th, 1907.

† See the *Worcestershire Advertiser*, February 16th, 1907.

in nurseries in Ireland, and were asked to take immediate steps to prevent the spread of the disease through the sale of such bushes. The reply was given in Parliament that the Board had no power to prohibit the importation or sale of such bushes.

At length, influenced perhaps by the mass of scientific evidence brought forward from other countries as well as from this, and by the number of Resolutions and Memorials asking for legislative action against the disease sent up to them month after month from Fruit-growers' Associations and Farmers' Clubs, the Board drafted a new Bill entitled "The Destructive Insects and Pests Act, 1907." This Government measure was introduced in the House of Lords by Earl Carrington, on March 21st, 1907. It passed the second reading on April 30th, on which occasion Earl Carrington made the statement that the object of the Bill was "to grapple with several matters of importance to the agricultural world, and in particular with the recently imported disease called the Gooseberry-mildew, about which so many questions had recently been asked in the House of Commons. The Bill provided that the Board of Agriculture might make such orders as were thought fit to prevent the introduction or spread of any particular insect, fungus, or other pest, destructive to agricultural or horticultural crops, or to trees or bushes. It gave the Board power to regulate the landing of plants and to authorise the removal or destruction of any diseased plant. Local authorities might pay compensation for any crops or trees so destroyed." The Bill passed its third reading in the House of Lords on May 13th last, and has now to pass through the House of Commons before becoming law.

Fortunately for fruit-growers generally, the Worcestershire County Council, on being informed last autumn of the presence of this new disease in their county, took energetic action. Mr. K. G. Furley, of Wye College, was employed during the winter to make a thorough inspection of gooseberry plantations in various parts of Worcestershire. I have received examples of the disease, mostly collected by Mr. Furley, from twenty-eight distinct plantations, situated chiefly in the neighbourhood of Evesham and Pershore.

Mr. Furley's investigations showed that the disease had obtained a firm hold in Worcestershire, and had already spread to a considerable extent. It was no doubt in consequence of this that the Board

of Agriculture has stated in the second Memorandum on the American Gooseberry-mildew that "the extent and seriousness of the disease are much greater than was at first supposed."

The disease having been as far as possible localised in the county, it was obviously of the greatest importance that the infected plantations during the next spring should be carefully watched and sprayed systematically to prevent the mildew spreading by its spores, for whilst in some plantations the mildewed shoots of the bushes, following the advice given by the Worcestershire County Council, had been cut off and burnt, in others this had not been done, or only partly. Since there was no hope of the Bill, if passed, coming into operation before midsummer, and since the mildew begins to spread in spring by its spores, application was made to the Board for a grant for the purpose of ensuring that every means were taken to prevent the disease spreading this season from the twenty-eight affected plantations. The answer given in Parliament was to the effect that "there is no prospect of a Government grant towards the expenses of spraying and other remedial measures."

It is unfortunately the case that in the spraying work carried out this spring by the Worcestershire County Council it has been found possible to treat only fourteen out of the twenty-eight plantations which are diseased, so that in fourteen plantations it will rest with the owner as to what kind of spraying is done, and in some cases it is only too certain that nothing will be done.

I would point out emphatically that this is not the way to deal with a new infectious disease if we wish to stop it spreading through the country. If preventive measures are to be taken, they must be thorough. Farmers would not be content if such half-measures were taken against infectious animal-diseases such as swine-fever, and fruit-growers should now unite to see that proper scientific attention is paid by the Board of Agriculture towards stamping out this plant disease.*

The case stands thus. The Board were warned of the danger of the invasion of Ireland by the American Gooseberry-mildew in 1900; they were warned again in 1902, in 1905, and in 1906.† For

* See remarks on p. 270.

† *Journal of the Royal Horticultural Society* (1900-07).

six years they have been watching the disease spread through Ireland, without taking any legislative steps. The Board, now that the disease has appeared in England in the midst of one of the chief gooseberry-growing districts, are beginning to realise its seriousness. In their first Memorandum, issued in December last, they state that "the disease has rendered the culture of gooseberries unprofitable and even impossible wherever it has appeared"; in their second Memorandum, issued in April last, they state "the extent and seriousness of the disease are much greater than was at first supposed." A Government Bill ("The Destructive Insects and Pests Act, 1907") has at length been brought forward, and is slowly making its way through Parliament; if passed, a special order will have to be issued to deal with the American Gooseberry-mildew. It will be past midsummer by that time, and it must be remembered that it is during June especially, and July, that the present disease spreads so rapidly by its summer-spores. The Board of Agriculture, acquainted in November last with the fact of the presence of the American Gooseberry-mildew in England, have not been able during the following six months to find means to deal, in a competent and scientific manner, with this new highly infectious plant-disease.

No published statistics are available as to the annual value of the commercial gooseberry crop in this country. I have obtained from some of the best known fruit-growers the following approximate estimate of the average annual value of the crop in different parts of England.

Kent	..	..	..	..	£60,000 to £120,000
Wisbech and district	..	..	..	..	£17,500 to £21,000
Evesham	..	..	..	..	£10,500 to £14,000
Calstock and district	..	..	..	..	£4,000 to £5,000
Gloucestershire	..	..	..	..	£5,250

I have not been able to obtain estimates for other parts of Worcestershire, for Herefordshire, and other fruit-growing counties, and for the gooseberry-growing districts in the south of Devon and neighbourhood of Penzance.

Putting on one side the value of the gooseberry-crop to the cottager and private gardener, it is safe to say that the annual value

of the commercial gooseberry crop in this country is represented by a sum of some hundreds of thousands of pounds.

Yet, at the present time when a new disease appears, which, as lately admitted by the Board, "has rendered the culture of gooseberries unprofitable and even impossible wherever it has appeared," no State grant is available to ensure the carrying out under scientific supervision of all possible spraying and remedial measures to prevent the spread of the disease from the comparatively few affected plantations as yet known in the country, and no scheme of compensation* is contemplated under which the disease could be resolutely stamped out by the compulsory grubbing up and burning of bushes, such as is taking place at the present time in countries on the Continent.

The condition of affairs shows the absolute necessity for the existence of a really representative and national federation of fruit-growers, whose aim it must be to secure for this country that State assistance and scientific attention to matters connected with fruit interests which the fruit-growers of other countries, and of many of our colonies, have already obtained.

E.S.S.

May, 1907.

POSTSCRIPT.

At the beginning of June I received examples of gooseberry bushes from Worcestershire, Gloucestershire and Norfolk (in the neighbourhood of Wisbech), with the berries, leaves and young shoots smothered with the white powdery masses of spores of the American Gooseberry-mildew. It is in this stage, by means of the spores, which are produced in myriads day by day, that this mildew spreads so rapidly through a district.

On June 19th, "The Destructive Insects and Pests Act," mentioned above, passed its third reading in the House of Commons.

* In the "Destructive Insects and Pests Act" now before Parliament the payment of compensation is left to the option of the local authority, and any such sum expended would not be provided by the Treasury.

The following paragraphs are taken from a letter I sent to the London Press* on June 22nd :—

“ . . . In November last I reported the discovery of the American Gooseberry-mildew in England. I then emphasised the danger of the Board of Agriculture delaying to take immediate and thorough measures against the disease, and urged that during the winter the bushes in all the diseased plantations should be grubbed up and burned, and that the necessary powers to deal with the disease should be obtained by the Board before the mildew entered the summer-stage, when it would spread by its spores. The Board were asked to bring in at once a short Amending Act to the Destructive Insects Act, 1877, still in force.

“ The outbreaks of the disease in its virulent and highly infectious summer-stage, which were then predicted, have now occurred ; the spores of the mildew are now blowing about and spreading the disease to fresh plantations, and the Board are still unprepared. It is true that ‘ The Destructive Insects and Pests Act, 1907,’ which has at length been brought in to deal with such plant diseases as the present, has now passed its third reading in the House of Commons. The Bill has, however, now to go up to the House of Lords for the approval of an amendment, and to receive Royal Assent ; then, when it is law, the Board will have to issue a special order to deal with the American Gooseberry-mildew.

“ It is such cases as these of procrastination and systematic neglect in matters vitally affecting the interests of fruit-growers that show the urgent necessity of the reform advocated in the first, and the most important, of the recommendations made by the Departmental Committee appointed by Lord Onslow in 1905, viz., ‘ That a special Sub-Department of the Board of Agriculture and Fisheries be established to deal with matters connected with the fruit industry.’

“ The Board of Agriculture are relying on the carrying out by the County Councils in the affected counties of work, which, in my opinion, should be performed by the Board itself. We have this new disease, which, as lately admitted by the Board,

* See *The Standard*, June 25th, 1907.

'has rendered the culture of gooseberries unprofitable, and even impossible, wherever it has appeared,' now spreading through the country, and yet on the application of county authorities, no State grant is available to ensure the carrying out, under scientific supervision, of spraying and remedial measures to prevent the spread of the disease from the comparatively few affected plantations and nurseries as yet known in this country; no mycologists are employed by the Board to investigate the disease; and no scheme of compensation is contemplated under which the disease could be resolutely stamped out by the compulsory grubbing up and burning of bushes—all of which measures are now being employed on the Continent against the present disease."

E. S. S.

June 26th, 1907.

HOP EXPERIMENTS.

BY

ARTHUR AMOS, B.A.

HOP SEASON, 1905-6.

The hop season opened with a favourable winter, and during some warm weather in April the hops began to grow ; May was a wet month, and at places hailstorms caused considerable damage by breaking off the shoots. The summer was warm, and for the most part, dry.

Aphis were exceedingly troublesome ; fly began to appear on the hops at the end of May, and fresh swarms continued to come throughout June and July ; these in many places caused great damage and necessitated constant washing ; however, the hops that survived were clean at picking. Mould was not very troublesome.

Owing to the lice the crop was small, but the quality was good in those gardens where the lice were killed in time.

Appended is the monthly rainfall from March till September :—

March 2.13 in., April 1.43 in., May 2.34 in., June 1.78 in., July .52 in., August .49 in., September 2.43 in.

I. MANURIAL EXPERIMENTS.

SELLING.—TENTH YEAR OF EXPERIMENTS.

“ The experiments at this centre have been devised to answer the question of what is the most profitable method to utilise a limited supply of dung, or how to replace it ?

“ Most hop-growers on a large scale find a difficulty in obtaining all the dung they would like to use in their gardens, and the point we have been testing is, whether it is more profitable to dung a portion of a garden thoroughly every two or three years, and farm between whiles with artificials, or whether it is better to use whatever dung may be available thinly over the whole garden every year, supplementing this with other purchased manures.

“Accordingly, one plot, A, receives at the beginning of the three year rotation which was adopted, a good dressing of thirty loads of farmyard manure, but gets no more for the next two years. The second plot, B, gets ten loads of dung every year, so that in three years it has received as much as A; the supplementary artificial manures are also so arranged that the two plots have each received exactly the same amount at the end of the three year period. A third plot, C, receives no dung, but artificial manures every year.”

See Table on page 337.

The experiments were started in 1897, so that the season of 1906 was the tenth of the series.

At the commencement of the experiments the land was in very good condition, and at the end of the first six years practically no difference was to be noticed between the yields from the three plots; it was thought that the rather heavy annual dressing to each plot, together with the original reserves stored in the soil, provided ample plant food for the hop crop; consequently, the manures supplied to each plot in 1903 and subsequent years were diminished by one-sixth.

Comparing, in the first place plot A (receiving thirty loads of dung once in three years) with plot B (receiving ten loads of dung every year), we see that the weight of hops produced on the two plots during each three-year period is almost identical, even in the third period, 1903 to 1905, after the manures have been diminished by one-sixth.

The conclusion therefore is, that in gardens in a high state of fertility, and where adequate nitrogenous artificials are supplemented, it is immaterial whether dung is put on in a lump once in three years, or whether it is divided up and a small dressing put on each year.

Coming now to plot C, which receives no dung, basic slag or superphosphate, but receives instead a double dressing of rape cake and fish guano, we see that the crop produced in 1906 was greater than that of either plot A or B for the first time during the experiment, owing to the fact that its bine was more fruitful; this result, in a season of so much blight as the last, is of no great importance.

SELLING.—MR. W. W. BERRY.

Cobb's Goldings on subsoil of Thanet Sand.

Manures per Acre.	PLOT.				
	A.			B.	C.
	1st.	2nd.	3rd.	Each Year.	Each Year.
Dung - -	30 loads	—	—	10 loads	—
Fish Guano -	—	7½ cwt.	7½ cwt.	5 cwt.	10 cwt.
Rape Dust -	—	7½ cwt.	7½ cwt.	5 cwt.	10 cwt.
Basic Slag -	10½ cwt.	—	—	3½ cwt.	—
Superphosphate	2½ cwt.	4 cwt.	4 cwt.	3½ cwt.	—
Kainit - -	—	3 cwt.	3 cwt.	2 cwt.	3 cwt.
Lime - -	1 ton '97 only	—	—	1 ton '97 only	—
CROP.					
1897 -	22.1 cwt.	—	—	20.5 cwt.	20.8 cwt.
1898 -	—	14.9 cwt.	—	14.9 cwt.	14.7 cwt.
1899 -	Crop not picked.				
Total 1st 3 years	37.0 cwt.			35.4 cwt.	35.5 cwt.
1900 -	11.0 cwt.	—	—	12.2 cwt.	11.8 cwt.
1901 -	—	21.6 cwt.	—	21.2 cwt.	20.6 cwt.
1902 -	—	—	16.7 cwt.	16.0 cwt.	15.7 cwt.
Total 2nd 3 years	49.3 cwt.			49.4 cwt.	47.1 cwt.
1903 -	12.8 cwt.	—	—	12.5 cwt.	11.5 cwt.
1904 -	—	15.7 cwt.	—	15.7 cwt.	15.8 cwt.
1905 -	—	—	16.6 cwt.	17.0 cwt.	16.7 cwt.
Total 3rd 3 years	45.1 cwt.			45.2 cwt.	44.0 cwt.
1906 -	5.8 cwt.	—	—	5.6 cwt.	6.3 cwt.

Throughout the whole experiment plot C has practically held its own with plots A and B, and in no three-year period has the difference in crop been more than 4 per cent., which is nearly within the limits of error of the experiment.

These figures then seem to show that dung can be substituted by artificial nitrogenous manures without any appreciable loss of crop when the soil is in good condition ; moreover, if we consider the value of a load of dung to be 6s. (which is somewhat arbitrary), the cost of the manures on plot B and plot C is also practically identical, plot C costing 5s. per acre less than plot B.

PLOT B.

			£	s.	d.
10 loads Dung at 6s.	-	-	-	3	0 0
5 cwt. Fish Guano at £7 10s. ton	-	-	-	1	17 6
5 cwt. Rape Cake at £7 ton	-	-	-	1	15 0
3½ cwt. Basic Slag at £2 15s. ton	-	-	-		9 6
3½ cwt. Super at £3 ton	-	-	-		10 6
2 cwt. Kainit at £2 15s. ton	-	-	-		5 6
			£7	18	0

PLOT C.

			£	s.	d.
10 cwt. Fish Guano	-	-	-	3	15 0
10 cwt. Rape Cake	-	-	-	3	10 0
3 cwt. Kainit	-	-	-		8 3
			£7	13	3

Mr. Berry has noticed that Plot C has had more mould than plots A and B during the last few years.

FRANT.—EIGHTH YEAR OF EXPERIMENTS.

“The plots at this centre were designed to test the requirements of the hop plant as regards mineral manures on the soil in question. At Marden, which is a stiff soil, real Weald clay, in fact, the experiments carried out by the College from 1895 to 1899 showed that the chief requirements of the soil were phosphoric

FRANT.—MR. E. DUNKLEY.
Fuggles on subsoil of Tunbridge Wells Sand.

Plot.	General Dressing.	Special Dressing.		Crop.				Crop.			
		1899-1902.	1903-1906.	1899.	1900.	1901.	1902.	1903.	1904.	1905.†	1906.
1	1899-1906. 15 cwt. Rape Dust -	None	None	—	4·8	19·8	6·4	8	10·2	68·5	1·7
2	„	5 cwt. Basic Slag -	6 cwt. Basic Slag - 6 cwt. Sulphate of Potash* - -	21·2	5·6	18·4	6·2	9·5	10·5	84·7	3·1
3	„	10 cwt. Basic Slag -	6 cwt. Basic Slag -	21·8	5·8	20·7	6·5	7·7	9·8	68·0	3·3
4	„	15 cwt. Basic Slag -	6 cwt. Steamed Bone Flour - -	21·3	5·3	19·6	6·8	7·1	9·7	65·1	3·1
5	„	5 cwt. Basic Slag - 5 cwt. Sulphate of Potash - -	6 cwt. Basic Slag - 6 cwt. Sulphate of Potash - -	24·8	6·7	21·6	10·2	8·6	11·7	76·1	3·1
6	„	5 cwt. Basic Slag - 10 cwt. Gypsum -	6 cwt. Basic Slag - 12 cwt. Gypsum -	23·2	6·0	23·0	8·6	7·7	11·2	70·1	2·1
7	None	None	None	—	5·0	18·4	6·5	5·2	7·9	36·8	1·8

* Reduced to three cwt. in 1905 and 1906.

† Picked in a thunderstorm, weight given green and wet

acid and lime ; these would increase the crop consistently, whereas potash salts had no effect. The soil at Frant is in complete contrast to that at Marden : it is a light, sandy loam, easily cultivated, though running together and setting to a very hard surface if heavy rain falls on a fine tilth. The manurial requirements of the Frant soil likewise present a complete contrast to those of the Weald clay, for whereas phosphates above a small quantity do not increase the yield, an abundant supply of potash has produced a marked effect on the crop, as also has gypsum, though to a less extent. The effect of the potash may be seen not only in the larger yield, but in the darker colour and increased vigour of the leaf and bine, which also ripen off at a later date. This is of course not an advantage on most soils, but it is just on the lighter sandy soils, where potash is effective, that a more prolonged growth is often desirable, for the plant in dry seasons is apt to run its course prematurely." (Hop Experiments by A. D. Hall, 1902).

See Table on page 339.

In 1903, as will be seen in the Table on page 339, the manuring was slightly altered, plot 2, which previously had had 15 cwt. rape cake and 5 cwt. basic slag only, receiving in addition 6 cwt. of sulphate of potash, whereas plots 3 and 4 have had their phosphates reduced to 6 cwt. of basic slag and 6 cwt. of steamed bone flour respectively.

The result of this has been that plot 2, which receives the same manure as plot 5, now produces a crop equivalent to that of plot 5, still further emphasising the needs of this light soil for potash ; further in the years 1903 to 1905, plots 3 and 4 have produced a smaller crop than plot 1, which receives no phosphatic manure, showing that not only have steamed bone flour and basic slag produced no increase, but on the contrary have produced a decrease in the crop.

In 1906, owing to the severe attack of aphid, the crop was nearly a total failure, and no conclusions can be drawn from it.

The crops obtained at this centre have fluctuated very greatly from year to year, making the effect of the various manures somewhat difficult to compare ; in order to make the results more comparable, they have been recalculated on the basis of taking the mean crop for each year of plots 2, 3, 4, 5 and 6 as 100.

The results are shown in the table below :—

Plots.	Manuring.	Crop relative to average.							
		1899	1900	1901	1902	1903	1904	1905	Mean '99-'05
2, 3, 4,*	Phosphates & Nitrogen only - -	95	95	95	85	91	91	91	92
*4, 5,	Phosphates & Nitrogen with Potash - -	110	113	104	132	111	103	111	112
6,	Phosphates & Nitrogen with Gypsum - -	103	102	111	111	95	112	96	104

N.B.—The 1906 crop is not included in this table, because, owing to the aphid attack, the results are unreliable.

* Plot 4 received Potash from 1903-1906 only, its results are therefore included in the first group 1899-1902 and in the second 1903-1905.

It is then seen that the crop from the plots receiving rape cake and phosphates only is in the mean 8 per cent. below the average, whereas the plots with potash as well as rape cake and phosphates, give in the mean a crop 12 per cent. above the average, and the plot with gypsum, rape cake and phosphates gives a crop 4 per cent. above the average.

FARNHAM.—SEVENTH YEAR OF EXPERIMENTS.

“ These plots are intended to compare the effect of dung and fur waste against a complete dressing of artificials : also to test the requirements of this soil for the mineral manures, lime, phosphoric acid and potash.”

The crop obtained last year at Farnham was very small owing to the severe attack of blight ; it will be seen that the crop at this centre has varied enormously from year to year, well over a ton in 1901 and less than 5 cwt. in 1902 and 1906.

This year the limed Plot, No. 4, once again produces the greatest crop, whilst Plot 2 with Rape Cake and 4 cwt. Steamed Bone Flour has yielded more than Plot 3 with a double dressing of Steamed

Bone Flour and Plot 5 with 2 cwt. of Sulphate of Potash in addition to the Plot 2 manures ; the dunged plot again produces the smallest crop.

FARNHAM.—MR. W. T. COLEMAN.

Farnham Whitebines on Alluvial Loam.

Plot.	General Manure per Acre.	Special Manures per Acre.	Crop.				
			1900.	1901.	1902	1905.	1906.
1	30 loads Dung	None - -	8.6	22.0	2.9	19.0	3.4
2	15 cwt. Rape Dust - -	4 cwt. Steamed Bone Flour	9.3	24.4	3.3	15.0	4.3
3	" " "	8 " " "	10.2	25.0	2.8	19.9	3.4
4	" " "	4 " " " and 1 ton Lime	11.5	26.8	4.2	16.6	4.8
5	" " "	4 cwt. Steamed Bone Flour and 2 cwt. Sulphate of Potash	9.7	27.9	3.7	18.1	4.0
6	1 ton Fur Waste	None - -	8.1	25.9	3.2	—	—

The results of the whole series show that Dung alone at this centre is not sufficient to produce a good crop, probably because the soil becomes sour through the decay of the excessive organic matter.

Lime on this soil is particularly beneficial ; the soil here naturally contains very little, and under the conditions of high farming for hops, what little there is becomes rapidly used up, during the decay of the dung, a dressing of lime then neutralises the sourness of the soil and aids in rendering the reserves of plant food in the soil available for the plant.

To still further emphasise the value of lime on this soil, the following table is reproduced.

EFFECT OF LIME.

		1895.	1896.	1897.	1900.	1901.	1902.	1905.	1906.	Average.
Without Lime	-	15.6	16.8	9.7	9.3	24.4	3.3	15.0	4.3	12.3
With Lime	-	21.8	20.0	12.1	11.5	26.8	4.2	16.6	4.8	14.7
Per cent.										
Increase - 19.5										

The figures include some earlier experiments carried out at the same centre from 1895-7.

It is seen that lime has produced a marked increase every year, amounting on the average to approximately 20 per cent.

Steamed Bone Flour has always produced a large increase at this centre ; it is particularly adapted for this soil and others very deficient in lime, because it supplies Phosphates, which are readily available, without the disadvantages of adding acid to the soil as is the case when Superphosphate or Dissolved Bones are applied.

Sulphate of Potash in small quantities produces a profitable increase of crop on an average, as shown by the yield of Plot 5.

SUMMARY.

It was arranged by my predecessor, Mr. F. Escombe, that the Manurial Experiments at Selling, Frant and Farnham should terminate in 1906 ; I am reproducing below a short summary by Mr. A. D. Hall, the originator of the experiments, upon the results of the manurial experiments up to 1902, since which time the conclusions arrived at have been still further strengthened.

“ The results of the manurial experiments in 1902 all go to strengthen the conclusion we had begun to form a year or two ago, that the hop plant is one which shows no special requirements in one direction or another, but is an all round feeder. It is not like the Swede crop which shows a special dependence on a free supply of Phosphates, or Potatoes which particularly need plenty of Potash, but the Hop requires what may be termed a normal mixture of all the elements of plant food.

“The problem of manuring hops satisfactorily then resolves itself into a study of the soil ; each type of soil has its own characteristics, which do not hold for other soils. For example, on the clay at Marden and Oxted our experiments have shown that Phosphates ought to be freely used, but Potash is not wanted, per contra at Frant Phosphates give no special return, but Potash dressings increase the crop. At Farnham again Lime is specially wanted, and at Selling there is no striking deficiency to be made up of any of the mineral plant foods.”

In earlier days, when a much smaller crop of hops was generally grown, it was sufficient to supply the land with an almost exclusively Nitrogenous dressing, such as Shoddy or Rape Dust or Dung (which is effectively a nitrogenous manure). Supplied with Nitrogen the plant was able to obtain its minerals for itself from the reserves in the soil. But latterly, when much larger crops per acre are grown, it is not enough to rely on nitrogenous manures alone : the mineral constituents of the soil cannot come into action quick enough to fully feed the crop, hence the need of supplementing the nitrogenous manure with a certain amount of mineral manure also.

On the typical hop soils, the deep loam and brick earths of East and Mid Kent and Farnham, these mineral manures need not be large in amount nor specially compounded, for such soils are well mixed and naturally contain all the elements required. It is where the crop has spread on to soils less suited to its development, on the clays, the sands, and other soils with a special rather than a general character, that the particular requirements of the crop must be studied by experiment and analysis, and where these investigations are in the end likely to be of most service.

II. CULTIVATION EXPERIMENTS.

GOUDHURST.—TWELFTH YEAR OF EXPERIMENTS.

The object of this experiment is the testing of the effect of dispensing with any cultivation beyond that necessary for keeping down weeds.

In 1895 one row in the garden was left uncultivated, this was extended in 1898 to several rows on either side, and finally in 1901

the whole garden, with the exception of the deep cultivation plot, was left uncultivated ; merely scratched over to a depth of one inch to kill weeds.

The garden is situated on a stiff soil, practically clay ; it is well manured with dung and artificials, producing big crops of Fuggles, for which the soil is eminently suited.

GOUDHURST.—MR. W. J. NOAKES.

Fuggles on Subsoil of Wadhurst Clay.

Plot.	Cultivation.	Crop.			
		1903.	1904.	1905.	1906.
A.	No Cultivation 12 years -	22.5	13.6	28.1	19.4
B.	Deep Cultivation each year -	20.9	11.4	20.4	17.3
C.	No Cultivation 6 years -	20.1	11.4	24.2	18.4

The results show that the plot uncultivated for twelve years has throughout produced a crop greater than the deep cultivated plot, and so also has the plot uncultivated for six years though to a less extent ; the uncultivated plots seem to improve from year to year.

Mr. Noakes finds, however, that it is not profitable to leave the whole garden uncultivated, owing to the difficulty of keeping the weeds in check, and in future, will cultivate it in the ordinary way to a depth of three or four inches during the season.

IMPORTANCE OF MALE HOPS.

We are continuing some experiments started by Mr. Howard, on the influence of the male hop upon the growth and development of the hop cones ; we should be greatly assisted if anyone noticing a garden, in which for some unknown reason the hops have not grown out, would inform us of the fact, so that we could examine the hops to find out the proportion of seeded bracts present.

A LIST OF PLANTS POISONOUS TO STOCK.

BY

S. T. PARKINSON, B.Sc. (Lond.)

and

EDWARD J. RUSSELL, D.Sc. (Lond.).

A LIST OF PLANTS POISONOUS TO STOCK.

By S. T. PARKINSON, B.Sc. (Lond.) and EDWARD J. RUSSELL, D.Sc.
(Lond.).

The following list has been drawn up, partly because of its utility to agriculturists, and partly also to draw the attention of chemists to the great amount of work waiting to be done on the compounds present in common wild plants.

In deciding whether a plant is or is not to be considered poisonous we have encountered several difficulties. The evidence that a particular plant is harmful is often meagre and sometimes conflicting ; and the difficulty is increased by the fact that animals show varying degrees of susceptibility, and plants said to be injurious to one may be practically harmless to others. As it was not our intention to exhaust the whole British flora, we have confined ourselves to fairly common wild plants, and we have in each case given our authority for including the plant. The list looks more formidable than it really is ; grazing animals will generally instinctively reject poisonous plants, or take so little that they suffer no obvious injury. There is, however, more danger when fodder is cut and carried to the animals, and in several of the recorded cases injury has arisen in this way. The danger often is less when the herbage is dry, as in hay ; in that condition some plants seem to lose their poisonous properties.

The substances which cause poisoning are not always known, and even where an alkaloid or a glucoside has been extracted from the plant it is by no means clear that the body obtained is the actual poisonous principle. Much work in this direction remains to be done both by the chemist and the physiologist. In the subjoined list references are given to recent papers dealing with

each substance. Many classical investigations are left out, but by beginning with the paper quoted the student will be able to trace his way through the literature of the subject.

The references to poisoning are quoted from the following among others:—

Journal of the Royal Agricultural Society (J.R.A.S.).

Cornevin, "Des plantes vénéneuses" (C.).

Strasburger, "Text Book of Botany" (Str.).

Henslow, "Poisonous Plants" (H.).

Information about the chemical substances present is given in:—

Brühl, Hjelt and Aschan. Die pflanzen alkaloide ((Vieweg 1900).

Van Rijn. Die Glykoside (Borntraeger, 1900).

Wiesner, Die Rohstoffe des Pflanzenreiches (Engelmann, 1903).

The arrangement adopted has been to put into Group I. those plants the poisonous character of which is fairly definitely established, and to put into Group II. those about which the evidence is less clear. Group III. contains plants or seeds which have been known to cause injury, but which animals would not get in an ordinary way.

All the plants in the list contain poisons, but it by no means follows that the plants are dangerous to stock. There is not a great deal of English literature, and Continental experience is not altogether a useful guide, because the approximate constituents of plants vary with the place of growth and the stage of development. The practical man has long recognised that a plant may be harmful at one time and much less so at another; and because a plant has produced dangerous effects on cattle in Central or Southern Europe it by no means follows that the same effects will be produced here. Much more information is wanted of the effect on the animal of the whole plant as well as of its harmful constituents.

Group I.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside).
Yew (<i>Coniferæ</i>)	<i>Taxus baccata</i>	Common tree	All parts poisonous, danger seems especially with shoots Old shoots or dried clippings considered most harmful. Danger increased because tree has no repellent odour. Horse poisoned, J.R.A.S., 1885, p. 336. Deer and Horses, J.R.A.S., 1893, p. 181. Shorthorns, J.R.A.S., 1893, p. 840; but see also J.R.A.S. 1893, p. 141 and 1892, p. 703.	<i>Taxine</i> , $C_{37}H_{53}O_{10}N$. Thorpe & Stubbs, Trans. Chem. Soc., 1902, p. 874.
Meadow saffron (<i>Liliacæ</i>)	<i>Colchicum autumnale</i>	Damp pastures (local)	The whole plant, particularly tubers and seeds Poison not removed by drying. Acrid and generally avoided. Cases most frequent in spring and autumn Many horses, ruminants and pigs killed. C. p. 96, J.R.A.S., 1905, p. 164.	<i>Colchicin</i> , (A) $C_{22}H_{25}NO_6$. <i>Colchicein</i> , (A) $C_{21}H_{23}NO_6 + H_2O$. Zeisel, Monatsh f. chemie, 1883, 4, 162. Beniche, 1888, 9, 865.
Annual mercury (<i>Euphorbiacæ</i>)	<i>Mercurialis annua</i>	Cultivated and waste land	{ Disagreeable smell. Stock usually refuse it. Fatal effect on horses fed on herbage cut from hedge. (In Yorksh. and at Aldworth). J.R.A.S., 1898, p. 561.	
Dogs' mercury	<i>Mercurialis perennis</i>	Woods, hedges, etc.		

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside).
Spearwort (<i>Ranunculaceæ</i>)	Ranunculus flammula	Wet places	Horses and cows killed at Gamlingay (Cambridgeshire), H. 39	
Tall crow-foot	R. acris	Roadsides and meadows	Frequent cause of poisoning in cattle. Str. p. 518. Intense inflammation. Flowers most dangerous parts.	
Bulbous buttercup	R. bulbosus	Meadows and pastures	Similar to above. C. 198.	
Celery-leaved crowfoot	R. sceleratus	Ponds	One of the most noxious sp. of buttercups. Str. p. 517.	
Cowbane or water hemlock (<i>Umbelliferæ</i>)	Cicuta virosa	Edges of ponds and ditches	Animals rarely touch it. C. p. 376.	Said to contain the same alkaloids as Conium maculatum.
Water dropwort	Enanthe crocata	Marshes and wet places	Cattle often poisoned after eating it, especially from clearings from ditches. Roots more poisonous than leaves. C. p. 379. Sheep and cattle died on a farm near Bristol. J.R.A.S., 1898, p. 561.	
Cherry laurel (<i>Rosacæ</i>)	Prunus laurocerasus	Shrubberies	Considered poisonous, but see H, p. 82. Leaves also said to be poisonous	<i>Laurocerasin</i> , (G) $C_{40}H_{67}NO_{30}$, Wiesner, Rohstoffe II., 582. <i>Amygdalin</i> (G) $C_{20}H_{27}NO_{11}$.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside.)
Rhododendron (<i>Ericaceæ</i>)		Gardens and woods	} Case of poisoning. Journal of Board of Agric., May, 1907.	<i>Ericolin</i> (G) $C_{33}H_{50}O_{21}$ (?). See Thal., Ber., 16, 1502 and Van Rijn, p. 337.
Azalea		Gardens		<i>Arbutin</i> (G) $C_{12}H_{16}O_7$. Schunck & Marchlewski Ann. d. Pharm., u. Chem., 278, 354.
Henbane (<i>Solanaceæ</i>)	<i>Hyoscyamus niger</i>	Waste places, generally near old buildings	Very disagreeable smell, but calves poisoned by eating it mixed with their food. C. p. 470.	<i>Hyoscyamine</i> (A) $C_{17}H_{23}NO_3$, Ladenburg, Ber., 1880, 13. 607; 1888, 21, 3065. <i>Hyocine</i> or <i>Scopolamin</i> , Laden- burg, Ber., 1880, 13, 1549; also Ann. Chem. Pharm., 1881, 206, 299. <i>Hyoscyipikrin</i> (G) Höhn, Arch. d. Pharm., 191, 215.
Bittersweet (<i>Boraginæ</i>)	<i>Solanum Dulcamara</i>	Hedges and thickets	Eaten by a cow. J.R.A.S., 1905, p. 164.	<i>Solanine</i> , (A) $C_{38}H_{47}NO_{11}+H_2O$. Cazeneuve and Breteau, Compt. Rend., 1899, 128, 887. <i>Dulcamarin</i> (G), $C_{32}H_{34}O_{10}$. Geissen, Arch. d. Pharm. (3), 7, 289.
Hound's tongue	<i>Cynoglossum officinale</i>	Bushy places	J.R.A.S., 1905, p. 164.	

Group II.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid G—glucoside.)
Herb Paris (<i>Liliacæ</i>)	Paris quadrifolia	Damp woods, especially on chalk	All parts poisonous. C. p. 124.	
Lily of Valley	Convallaria majalis	Woods	Flowers most dangerous. C. p. 120.	<i>Convallamarin</i> (G) $C_{23}H_{44}O_{12}$. Walz, N. Jahn. f. Pharm. Vols. V. and X. <i>Paradin</i> (G) $C_{33}H_{56}O_{14}$ (Walz) <i>Convallarin</i> (G) $C_{34}H_{62}O_{11}$. (Walz).
Lords and ladies, or Cuckoo pint (<i>Aroidæ</i>)	Arum maculatum	Hedgebanks, occasionally in meadows	All parts, loses virulence on drying. Bruised leaves have unpleasant smell and acrid taste. Cattle refuse it. Pigs harmed, but not fatally. C. p. 64.	
Sheep's sorrel (<i>Polygonacæ</i>)	Rumex Acetosella	Sandy places	Horse and sheep said to be affected. C. p. 150.	
Darnel (<i>Gramineæ</i>)	Lolium temulentum	Cornfields	Only the grain poisonous. Danger due to presence of a small fungus. (Freeman).	
Monkshood (<i>Ranunculacæ</i>)	Aconitum Napellus	Gardens. Other- wise rare	Roots most dangerous. Maximum toxicity of leaves just before flowering. C. p. 212.	<i>Aconitine</i> , $C_{34}H_{47}NO_{11}$. (A). Freund & Beck, Ber. 1894, 27, 720. Cf. Dunstan. J.C.S. 1897, 350.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside.)
Bear's foot	<i>Helleborus foetidus</i>	Woods on limestone (rare)	Animals have been killed by it. C. p. 206	<i>Helleborin</i> (G.) $C_{36}H_{42}O_6$. <i>Helleborein</i> (G.) $C_{37}H_{40}O_{18}$. Husemann and Marmé, Ann. d. Chem. u. Pharm. 135, 55; also Thaeter Arch. d. Pharm. 1897, 235, 414.
Wood anemone	<i>Anemone nemorosa</i>	Woods, occasionally meadows	Cattle poisoned after being underfed and kept on dry food. C. p. 193	
Larkspur	<i>Delphinium</i>	Gardens, otherwise rare	Seeds poisonous. Some American species considered fatal to stock. (Year Book N.S. Agric., 1900, p. 317)	<i>Delphinin</i> (A) $C_3H_4NO_7$. <i>Delphinisin</i> (A) $C_{31}H_{40}NO_7$. <i>Delphinoidin</i> (A) $C_{42}H_{68}N_2O_7$ (?) { Kara-Stojanow, Chem. Centr. 1890, 2, 625.
Field Poppy (<i>Papaveraceæ</i>)	<i>Papaver Rhœas</i>	Cornfields	All parts poisonous. Proved fatal to cows. C. p. 234	<i>Morphine</i> (A) $C_{17}H_{19}NO_3 + H_2O$. <i>Rhœadin</i> (A) $C_{21}H_{21}NO_6$, Hesse, Ann. Chem. Pharm. 1869, 149, 35.
Spindle tree (<i>Celastraceæ</i>)	<i>Euonymus europæus</i>	Bushy places, often on chalk	All parts, but especially berries, poisonous. Sheep and goats injured by leaves. C. p. 271.	<i>Euonymin</i> (G), Prescott, Amer. J. Pharm., 1889.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside.)
Box (<i>Euphorbiaceæ</i>)	Buxus sempervirens	Hedges	Disagreeable smell and taste. Said to have poisoned animals. C. p. 271	<i>Buxin</i> (A) $C_{18}H_{21}NO_3$ Fauré Berz. Jahresber, 1830, 11. 245, Walz, Jahresb, 1860, 548. <i>Parabuxin</i> , <i>Buxinidin</i> , <i>Parabuxinidin</i> Barbaglia, Ber. 1884, 17, II. 2655.
Spurge laurel (<i>Thymeleaceæ</i>)	Daphne Laureola	Copses (rare)	All parts acrid and poisonous. So bitter that animals refuse it. C. p. 160	
Hemlock (<i>Umbelliferæ</i>)	Conium maculatum	By streams	Generally rejected on account of its smell. Most dangerous when they are put out to grass in spring. C. p. 367. Is much less dangerous when cut and dried, as hay. H. p. 90 See also J.R.A.S. 1905, p. 165.	<i>Coniin</i> (A) $C_8H_{17}N$ Ladenburg Ber. 1886, 19, 2582. <i>n. Methylconiin</i> (A) $C_9H_{19}N$ Passon, Ber. 1891, 24, 1678. <i>Conydrin</i> (A) $C_8H_{17}ON$ Hofmann, Ber., 1885, 18, 5. <i>Pseudoconydrin</i> $C_8H_{17}ON$ Ladenburg and Adam, Ber. 1891, 24, 1671. See also Lehmann, Ber. 1894, 27, 1781. <i>γ-conicein</i> , $C_8H_{15}N$ Wolfenstein, Ber. 1895, 28, 302.
Foxglove (<i>Scrophulariaceæ</i>)	Digitalis purpurea	Banks and woods	All parts poisonous. Str. p. 604. Cultivated varieties said to be less poisonous than wild. Stock reject it. C. p. 491	<i>Digitalin</i> (G) $C_{35}H_{56}O_{14}$. <i>Digitonin</i> . <i>Digitoxin</i> , $C_{34}H_{54}O_{11}$. <i>Digitophyllin</i> . Kiliani, Ber., 1899, 2196, 2201. See also Schmiedenberg, quoted in Van Rijn, p. 413.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside.)
Deadly night-shade (<i>Solanaceæ</i>)	<i>Atropa Belladonna</i>	Thickets and banks	More poisonous to man than animals. C. p. 457 See also J.R.A.S. 1905, p. 165.	<i>C. Atropine</i> , (A) $C_{17}H_{23}NO_3$, Ladenburg, Ber. 1879, 12, 941, also Ann. Chem. Pharm. 1883, 78, 217. <i>Hyoscyamine</i> , (A) $C_{17}H_{23}NO_3$, <i>Apoatropin</i> , Hesse, Ann. Chem. Pharm., 1891, 261, 87; 1893, 277, 290.
Potato	<i>Solanum tuberosum</i>	Cultivated	Animals suffer from eating green tubers	<i>Solanine</i> (see under Bitter-sweet).
Greater Celandine (<i>Papaveraceæ</i>)	<i>Chelidonium majus</i>	Banks near cottages	Animals do not take it. C. p. 238.	<i>Chelidonin</i> (A) $C_{20}H_{19}NO_5$, + H_2O . Schmidt and Selle, Chem. centr., 1890, 706. α <i>Homochelidonin</i> , $C_{21}H_{21}NO_5$, β <i>Homochelidonin</i> , $C_{21}H_{21}NO_5$, Schmidt and Selle, loc. cit. <i>Chelerythrin</i> , $C_{21}H_{17}NO_4$. König and Tietz, Chem. Centr., 1893, 785, 983. <i>Protopin</i> , $C_{20}H_{17}NO_5$. König, Chem. Centr., 1893, 984. These have all been extracted from the root.

Group III.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (A—alkaloid. G—glucoside.)
Corn cockle (<i>Caryophyllaceæ</i>)	<i>Agrostemma</i> <i>Githago</i>	Cornfields	Animals reject the growing plant. Poisoning due to grain, <i>e.g.</i> , in mill screenings. Experiments on calves, fowls and pigs fatal. C. p. 248.	<i>Agrostemma-sapotoxin</i> , $C_{17}H_{28}O_{11}$ Kruskal, 1891, quoted by Van Rijn, Die glykoside p. 173.
Castor-oil plant (<i>Euphorbiaceæ</i>)	<i>Ricinus</i> <i>communis</i>	Foreign plant	Seeds poisonous. Grows as weed amongst cotton crop. Eighty sheep died from eating refuse of oil crushing mill. Has been found as an impurity in linseed cake and maize meal. J.R.A.S.; 1892, p. 597.	<i>Ricin</i> . $C_{17}H_{18}N_4O_4$. Soaver Chem. Centr. 1895, 1, 853. See Halenke and Kling, (Landw. Versuchs. Stat.), Vol. 64.
Wild mustard or charlock (<i>Crucifereæ</i>)	<i>Sinapis arvensis</i>	Arable and waste places	Seeds only dangerous. Causes inflammation of intestine Case of poisoning by rape cake containing wild mustard, J.R.A.S., 1875, p. 516 and 1876, p. 291. The whole plant has irritant properties when in flower. C. p. 243.	<i>Sinabin</i> (?) (G). <i>Sinapin</i> (4). $C_{16}H_{23}NO_5$, Remsen and Coale, Amer. Chem. J., 1884, 6, 52.
Laburnum (<i>Leguminosæ</i>)	<i>Cytisus</i> <i>Laburnum</i>		Bark and seeds considered harmful. C. p. 288.	<i>Cytisin</i> . $C_{11}H_{14}N_2O$ Partheil Ber. 1894, 24, 634.

COMMON NAME.	BOTANICAL NAME.	HABITAT.	POISONOUS PROPERTIES.	CHEMICAL SUBSTANCES PRESENT. (<i>A</i> —alkaloid. <i>G</i> —glucoside.)
Oak <i>Amentaceæ</i>	<i>Quercus Robur</i>	Common tree	Young cattle liable to acorn poisoning in long dry summer. J.R.A.S. 1871, pp. 451 and 454. Board of Agric. leaflet No. 13.	
Ergot <i>Ascomycites</i>	<i>Clariceps purpurea</i>	On rye and various grasses	Often stated to be injurious to stock.	
Indian tares <i>Leguminosæ</i>	<i>Lathyrus</i> sp.	Foreign plant	Seeds are poisonous. Have been used to adulterate peas. Horses of the Bristol Tramways Co. poisoned, 1849. H 77.	
Java and Burma beans	<i>Phaseolus lunatus</i>	Foreign plant	Seeds are poisonous. Outbreak of poisoning in Scotland. (Trans. High. Agric. Socy. 1907, p. 139.)	<i>Phaseolunatin</i> (a cyanogenetic glucoside) $C_{10}H_{17}O_6N$. Dunstan and Henry, Proc. Roy. Soc. 1903, 72, 285.

VETERINARY NOTES.

BY

T. W. CAVE, F.R.C.V.S.

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VETERINARY NOTES.

“STRUCK” SHEEP EXPERIMENTS.

During the years 1903 and 1904 an attempt was made to immunise sheep against the disease commonly termed “struck,” by the use of vaccines prepared for the protection of cattle against black-quarter.

As formerly mentioned, the carcase of a struck sheep presents great similarity in its morbid appearances to that of a beast which has died of black-quarter. A bacillus is also found in the diseased flesh of struck sheep which closely resembles the bacillus of black-quarter. From these facts the natural conclusion was that the vaccine used for the protection of cattle against black-quarter might with advantage be used for the protection of sheep against being struck.

In all, 308 sheep were vaccinated during October, November and December of 1903. Of these fourteen died within a few days after vaccination as the direct result of the operation. It was thus shown that whatever degree of protection might be given to the vaccinated sheep, the loss from vaccination was too great to allow of the experiments being continued as far as the use of the black-quarter vaccine was concerned.

When the records of the number of sheep “struck” among the vaccinated and unvaccinated animals were examined in the summer of 1904, it was found that there was a marked difference in the percentage of deaths in the two lots of animals, the vaccinated and unvaccinated, especially where the double vaccine had been used. Among sixty-nine sheep which had received two injections of the vaccine only *one* was “struck,” equal to a loss of 1.44 per

cent., while of the 161 unvaccinated sheep pastured on the same ground, eleven were "struck," equal to a loss of 6.83 per cent.—a clear saving of 5 per cent.

It will thus be seen that a certain measure of success had been attained, although the method adopted could not be recommended, owing to the possibility of losses being incurred at the time of vaccination.

As it seemed clearly proved that it was possible to immunise sheep against being "struck" by the use of black-quarter vaccines, it was thought desirable that an attempt should be made to produce a vaccine specially prepared for sheep, and that further experiments should be made in this direction.

In September, 1904, a visit was paid to the Laboratory of the Alfort Veterinary College, near Paris, in order to inquire into the methods adopted by Professor Vallée for the protection of cattle against black-quarter.

I was courteously received by Professor Vallée, and was given every opportunity of seeing the splendid institution devoted to the teaching of Veterinary Science. Professor Vallée kindly gave me a detailed account of the methods adopted by him for the cultivation of the bacillus of black-quarter and the preparation of vaccines, and antitoxic serum.

As the work now required the equipment of a bacteriological laboratory, an appeal was made to the Governors of the College to provide funds for this purpose.

The laboratory was at length fitted up with the necessary apparatus, and a start was made during the summer term of 1905.

Unfortunately only a few experiments were possible at this period, as at the close of the term extensive alterations of the buildings, in which the laboratory was situated, were begun. It was soon seen that under the existing circumstances all work of a bacteriological character was quite impossible, and the work had to be abandoned until the beginning of 1906.

In February, 1906, a parcel of the flesh of a "struck" sheep was sent to me from Romney Marsh for examination. The flesh had the characteristic sour smell, and on microscopical examination of the muscle juice the bacilli usually found in the flesh of a "struck" sheep were detected.

A small quantity of the flesh was ground in a mortar and a little sterile saline solution was added. The fluid was then extracted from the flesh by squeezing through wetted linen. A large male guinea-pig was then inoculated with .5 cc of the fluid, which was injected deeply into the muscles of the thigh.

The guinea-pig died in about thirty-six hours after inoculation.

The leg was greatly swollen and was distinctly emphysematous. The skin was of a dark purple colour. On removing the skin the muscles were found to be very dark in colour, and were saturated with a blood-stained serum, and gas escaped on incision. The appearances were identical with those seen in a "struck" sheep. A microscopical examination of the fluid squeezed from the diseased flesh was made and numerous bacilli, resembling those found in the flesh of a "struck," were discovered.

The virus was then passed rapidly through several guinea-pigs and was greatly intensified, death now occurring in about fifteen hours after inoculation.

An attempt was next made to obtain a pure culture of the bacillus. The method adopted was that recommended by Professor Vallée.

A flask containing 200 c.c. of bouillon de Martin was prepared. In the bouillon 4 per cent. of glucose was dissolved, to which were added a few small pieces of chalk. The bouillon was then covered with a layer of oil of vaseline, the flask was plugged with cotton-wool, and then sterilised in the autoclave. When sufficiently cool, the flask was ready for use.

A guinea-pig inoculated the previous day, and now in a dying condition, was killed under chloroform, and then immediately dissected with sterile instruments, and the heart was exposed. A sterilised pipette was plunged into the right auricle and the blood was extracted, and then conveyed to the bouillon in the prepared flask.

The flask was then placed in the incubator. In two or three days bubbles of gas were to be seen rising through the layer of oil, and the bouillon had become turbid.

At the end of five or six days a little of the bouillon was taken from the flask with a sterile pipette. It was found to have an odour resembling that of sour milk. Microscopical examination

of the fluid showed the presence of large numbers of bacilli in pure culture. The bacilli were actively motile, and when stained were found to have rounded ends.

In this way a pure culture of the bacillus found in the flesh of a "struck" sheep was obtained. The cultivation of the bacillus was kept up in the laboratory for several months by inoculating a guinea-pig every few weeks with a small dose of the last culture, and taking the heart blood from each animal immediately after death, and with it inoculating fresh flasks of the prepared medium.

The bacillus was found to grow luxuriantly in the medium de Martin, and the gas formation continued for several weeks. When gas ceased to escape from the medium the liquid soon became clear owing to the settling of the bacilli to the bottom of the flask where they appeared as a thick sediment. It was found that the cultures remained virulent for about three months.

The bacilli were found in the guinea-pig in the muscle, on the surface of the liver, in the spleen, and in the bile taken from the gall-bladder. Although the method of obtaining pure cultures from the heart-blood proves the presence of the bacilli in the blood, they exist in that fluid in such small numbers that they cannot be detected by microscopical examination.

The bacilli stain readily with the ordinary stains, but I found gentian violet to be specially suitable. With Gram's stain the reaction is positive with the bacilli found in the muscle of the guinea-pig, but the bacilli in the cultures do not retain the stain.

The bacilli were found to be fatal to the rabbit. A large male rabbit was inoculated with .5 c.c. of emulsion of muscle of inoculated guinea-pig, and was found dead twenty hours later. On post-mortem examination the usual morbid appearances were seen, and numerous bacilli were found in the muscle juice.

A yearling calf was inoculated in the muscles of the shoulder with 2 c.c. of emulsion of muscle from an inoculated guinea-pig.

In eighteen hours a large swelling was found at seat of puncture. The swelling was hard, and tender to the touch. The temperature in the rectum was 103°.

In twenty-six hours after inoculation the swelling had greatly increased in size, was still tender to the touch, but was becoming emphysematous. Rectal temperature 103.9°.

At forty-two hours after inoculation the temperature had fallen to 102.2° , and continued to fall until normal. The swelling become bladder-like and resonant on percussion. Ultimately some suppuration took place, a small discharge of odourless pus followed, and the wound healed. The calf completely recovered in about three weeks after inoculation.

This experiment was tried in order to examine the morbid appearances after death, and to see whether the lesions produced in a calf by the bacillus of "struck" were identical with those of black-quarter. Unfortunately, the dose given was too small to cause death, but the symptoms produced were strongly suggestive of black-quarter.

I have since been informed by Sir John McFadyean that virulent black-quarter muscle could not be obtained from an inoculated guinea-pig in sufficient quantities to cause the death of a calf.

As the calf had recovered from the effects of the inoculation just described, it was thought desirable to use the animal as a serum producer, after the method suggested by Professor Vallée.

An injection of virulent culture was next given, without causing lameness or swelling, and with only a slight rise of temperature. Week by week from this time gradually increasing quantities of virulent culture were given, until the calf had received at a single dose as much as 120 c.c. of the culture. From time to time a few doses of emulsion of virulent muscle from guinea-pigs were also given.

It was intended to give a final dose of 200 c.c., but unfortunately urgent private affairs caused my absence from the laboratory, and on my return I found it was impossible to maintain the cultures, as they had now become so much attenuated that the guinea-pigs did not succumb until forty-eight hours after inoculation, and no growth of bacilli could be obtained from the heart's blood.

The failure of the cultures just at the critical period was a great disappointment to me, as owing to the seasonal character of the disease a fresh supply of flesh from a "struck" sheep was not likely to be obtained for some months.

At the same time that the above experiment was in progress, attempts were made to prepare vaccines from the cultures, and

some measure of success was attained before the work was stopped for want of virulent material.

The cause of the weakening of the cultures at a critical period appears to be the non-observance of a part of the instructions received from Professor Vallée. The bacillus ought to have been passed through a sheep every three months, but anxious to practise economy, I only made use of guinea-pigs.

From the work of the last year much has been learnt. The bacillus has been isolated from the flesh of a "struck" sheep. It has been successfully cultivated in the laboratory for several months. Various methods of preparing the vaccines have been tried. A calf has been hyperimmunised for the preparation of an antitoxic serum. Although no experiments on sheep have been carried out in the field, the time occupied in the study of the organism in the laboratory has by no means been wasted. The work already done will have an important bearing on the experiments to be carried on during the present year.

In conclusion, I may say that repeated examinations have shown that the bacillus of "struck" sheep is a fairly stout rod with rounded ends. The bacilli show no tendency to form filaments either in the tissues or in the cultures. In the tissues of the sheep, or guinea-pig examined immediately after death, the bacilli are not sporing, but if examined a few hours later many sporing rods are to be seen. The spores are situated either in the middle or at the end of the rods. I have made a careful comparison of the bacilli from the tissues of a "struck" sheep with those obtained from black-quarter in cattle, and I have failed to detect any differences between them. There seems to me to be no doubt that the bacillus of "struck" sheep is closely allied to if not absolutely identical with that of black-quarter in cattle.

PARASITES OF THE FOURTH STOMACH OF CATTLE AND SHEEP.

During the past year I have again been called upon to investigate outbreaks of disease among sheep which have been found to be suffering from pernicious anæmia due to the presence of parasites in the fourth stomach.

As the symptoms seen in sheep are of an indefinite character, and as the parasites are easily overlooked unless a searching examination is made of the contents of the fourth stomach, valuable time is often lost before the true nature of the disease is discovered. In such cases serious loss of life is frequently seen in spite of any treatment which may be adopted. To be successful in the treatment of this disease it is all important that an early diagnosis should be made and suitable remedies administered before the animals have become so much weakened and exhausted by the ravages of the parasites that they cannot recover, even though all the worms are successfully expelled from the stomach.

Where sheep are found to gradually waste away and die without showing any other symptoms of disease, a careful examination of the contents of the fourth stomach by the veterinary surgeon will probably reveal the presence of the parasites. Treatment should then be given to the whole flock and heavy loss may be prevented.

During the past year investigations of two outbreaks of disease in young cattle have been made, in which the serious losses in each herd were found to be due to the presence of parasites in the fourth stomach.

In July last an outbreak was reported in Sussex, in which a number of calves had died from chronic diarrhœa.

On visiting the animals they were found to be in an extremely emaciated condition, and were evidently suffering from diarrhœa. The calves had been living out in the pasture for about two months.

and for the last four weeks had been gradually losing condition. They were all more or less scouring.

Various remedies for the treatment of scour had been tried without success.

I was fortunately able to make a *post mortem* examination of a calf which had reached the last stages of the disease. It was in a dying condition, and was extremely emaciated. Profuse diarrhœa was present, and the evacuations contained a considerable amount of blood. As the case was clearly hopeless, the animal was slaughtered for my inspection, and the fourth stomach, with its contents, was sent to the laboratory for examination.

The whole of the intestines showed considerable evidence of disease, the mucous membrane being greatly congested.

A careful examination of the contents of the fourth stomach ultimately revealed the presence of large numbers of small delicate nematode worms. Although not small enough to be described as microscopic, they were quite invisible to the naked eye when mixed with the ingesta.

An examination of a thin layer of the ingesta, spread over a black surface, and with the aid of a lens, soon discovered the presence of these small parasites, which could then be picked out with a needle.

The mucous membrane of the stomach was congested in patches and showed a few small red papular elevations. I was unable to detect any parasites in the mucous membrane itself, but a few worms were still clinging to the membrane. A microscopical examination of stained preparations of the worms showed that they were in various stages of growth.

Adult worms were sent away for identification, but no one in England seemed able to recognize them. They were then sent to Professor Railliet, of Paris, who declared them to be specimens of *Strongylus ostertagi*, a parasite which had been found to infest cattle on the Continent, but which had not been known to occur in Great Britain.

The calves still remaining alive were placed under treatment. Anthelmintic remedies were prescribed, followed by tonics and good dry food. I afterwards heard that no further loss occurred and that the calves gradually recovered their condition.

During the past winter a number of young cattle were reported to be gradually wasting away, with occasional attacks of diarrhœa. I was asked by the veterinary surgeon in attendance at the farm to examine the fourth stomach, as he suspected the presence of parasites. On receiving the stomach the contents were placed in a glass jar and washed frequently with water; when ready for examination a thin layer of the ingesta was spread over a black surface, but no parasites were seen even with the aid of a lens. The point of a needle was then dipped into the material and immediately washed in a little water. It was now found that every dip of the needle into the ingesta brought up several small worms. Ultimately some hundreds were collected in this way, and stained specimens were prepared for examination. Some of these worms were sent to Professor Railliet for identification, by whom they have been recognised as a mixture of *Strongylus ostertagi* and *Strongylus cervicornis*.

As there was no doubt that the parasites were the cause of the emaciation and diarrhœa it was decided to recommend the owner to try the effect of treatment in those animals which yet survived.

There has not yet been time for the treatment to be given a fair trial, but it is hoped that the progress of the disease may be arrested by the destruction of the worms, and that recovery may take place.

My investigations into the causes of outbreaks of pernicious anæmia in both cattle and sheep have shown that small parasites infest the fourth stomach in enormous numbers, and that they are responsible for the emaciation and extreme debility which occur. Diarrhœa may or may not be a symptom of the disease. When diarrhœa does not occur the animals affected may reach a condition of extreme debility before the attention of the owner or attendant is attracted; it may then be too late for treatment to be successful.

“GID” OR “POTHERY” IN LAMBS.

On several recent occasions my attention has been directed to outbreaks of disease in lambs, which were suffering from the earliest symptoms of “Gid” or “Pothery.”

The symptoms of the later stages of “pothery” are so well known that no reference need be made to them here, but I wish to call attention to the fact that severe loss may be experienced at the time of the invasion of the brain by the parasites, and before the well known hydatids have developed.

At the end of last summer I was asked to visit a flock of lambs in which some twenty deaths had already occurred, and in which many animals were seen to be suffering from obscure symptoms of some brain affection. The affected lambs were dull and weak. They walked with a staggering gait as if intoxicated. The head was carried high and to one side. When caused to gallop the animals gradually turned to left or right, and had difficulty in controlling the movements of the limbs; in some cases the hind legs were dragged on the ground.

Occasionally symptoms were seen as if the animals were suffering from fits: eyes squinting, the neck-contorted, spasmodic contractions of the limbs and frothing at the mouth.

On post-mortem examination it was at once seen that the coverings of the brain were deeply congested, and on examining the brain itself, superficial furrows of a pale yellow tint were seen. A careful search showed the presence of a number of small newly formed hydatids, no bigger than a very small pea, in which there were no heads to be found.

In all cases examined post-mortem, it was possible to discover the presence of these small hydatids, and it was clearly shown that the symptoms above described were brought about by the invasion of the brain of the lamb by a number of embryos. The furrows on the surface of the brain were caused by the wandering embryos before they settled down to form the hydatids.

The lambs, whose brains are invaded by a number of parasites, may die from encephalitis, or they may apparently recover for a time only too surely to develop the usual symptoms of "gid" at a later period. It is said that in a small percentage of cases the lambs may in this early stage completely recover, owing to the parasites perishing and shrivelling up.

It is again necessary to point out the danger of allowing dogs to eat the heads of pothery lambs. It is only in this way that the disease in lambs can be spread, and yet one often hears that the heads of pothery lambs are thrown to the dogs, with the result that the dogs are infested by the Gid-tapeworm and spread the eggs of the tapeworm over a wide district, causing serious outbreaks of pothery among the lambs at a later period.

The heads of all pothery lambs should be destroyed by burning, and farmers should insist that butchers who buy their pothery lambs should destroy the heads, and not dispose of them to be used as food for dogs.

A CASE OF ANTHRAX IN A COW WHICH WAS UNDERGOING THE TUBERCULIN TEST.

I am anxious to place on record the remarkable coincidence of a cow dying from anthrax while undergoing the tuberculin test.

The cow, one of a herd of dairy cows being tested for tuberculosis, was found dead on the morning after receiving the usual dose of tuberculin. The cowman naturally thought that death was due to the tuberculin, but an examination of the blood, both by the veterinary surgeon, who was testing the animals, and myself, showed the presence of bacilli anthracis in large numbers. The bacilli gave the characteristic rose-coloured reaction with methylene blue. This case well illustrates the necessity of always suspecting the possible presence of anthrax whenever an animal dies suddenly.

T.W.C.

GENERAL NOTES.

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GENERAL NOTES.

COLLEGE SESSION, 1906-7.

INAUGURAL ADDRESS BY PROF. H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.,
ON
THE OPPORTUNITY OF THE AGRICULTURIST.

Some among you who have learnt to read—not merely to play with books but to know them as real friends : to consult them and consider them—will remember the lines in Tennyson's "In Memoriam" :—

They say,
The solid earth whereon we tread,
In tracts of fluent heat began
And grew to seeming random forms,
The seeming prey of cyclic storms.

The day was, we are led to suppose, when our globe was a fiery fused mass. Its atmosphere was a strange one in its early stages—full of steam and acid fume. Gradually, the mass cooled down and the crust became solid ; there is some reason to think that contraction took place along lines which determined the formation of the great ocean basins very much in their present positions on the earth's surface. As the acid steam condensed, falling as rain on the land, it dissolved out certain materials, washing them into the oceans and at the same time carving out deep valleys in every direction. The salt we know to-day may well be the actual

salt made in those far-off times—while all else is changed. To quote again from Tennyson's poem :—

There rolls the deep where grew the tree,
 O earth what changes hast thou seen !
 There where the long street roars, hath been
 The stillness of the central sea.

The hills are shadows and they flow
 From form to form and nothing stands ;
 They melt like mist, the solid lands,
 Like clouds they shape themselves and go.

I ask those who can read and who have read to ponder over these magnificent lines ; I would urge all who cannot, to begin, in order that they may understand their extraordinary significance. The wonderful art the poet exercises of compressing a whole history into a few short sentences—the marvellous power of words to excite long trains of thought—is nowhere better displayed ; but the power of the words in themselves is nil—they acquire meaning only when the will exists to give meaning to them.

My object, however, in quoting Tennyson's lines, is to ask you to think of them as descriptive of the genesis of agricultural soils. The primary soils were undoubtedly sands and clays formed by the decay and disintegration of the erstwhile molten crust—of rock like that known to us now as granite, made up of at least three different crystalline materials : felspar, mica and quartz. Quartz is indestructible except mechanically and mica is not easily affected ; felspar, however, is sooner or later broken down under ordinary atmospheric influences, into clay and soluble matters ; granite therefore gradually disintegrates on exposure, owing to the decay of its felspar.

In the earliest times as now, the clays thus formed, being in a very fine state of division, would have been carried far out to sea and only slowly deposited ; but the streams which conveyed the clay out to sea would also grind down the mica and the quartz, until eventually the one was converted more or less into clay and the other into quartz pebbles and sand grains, which also were conveyed greater or less distances out to sea and deposited as sediment on the ocean floors : in this way, gravels, sands and clays were laid down contemporaneously—but in different regions.

The thickness of rock which underwent disintegration must have been enormous, considering the enormous thickness of the sedimentary rocks.

But sand and clay are not the only rocks known to us : those of you who are at home in this district are aware of the existence in it of a vast mass of chalk. In what relation does this stand to sand and clay ? How will you find out ? No detective attempts to unravel the mystery of a crime from his armchair—he goes out into the world and seeks for signs : and so must you if you desire to solve the many problems which limestone presents.

No doubt there are chalk pits to be found and the coast is open to inspection. Suppose you visit the pits, hammer in hand : using your eyes, you will sooner or later light upon shell remains and Tennyson's lines will come home to you :—

There where the long street roars, hath been
The stillness of the central sea.

Under the microscope, chalk bears most distinctly the impress of a manufactured article—far from being amorphous like clay and sand, it consists for the most part of particles which are obviously remains of organisms. Within recent years, the origin of chalk has been disclosed by the discovery over vast regions of the ocean floor, in the Atlantic and Pacific areas, of an ooze or deposit precisely similar in appearance to chalk ; the formation of this ooze has been traced to the warm surface, where the organisms themselves flourish ; as they die, their outer shelly casings sink slowly through the deeps where they are deposited, forming what is now called *Globigerina* ooze. Chalk, therefore, is also a sedimentary deposit but of organic origin, laid down in clear water in regions beyond those to which clay is carried—in central seas, in fact. As chalk yields lime when burnt, it is a form of limestone. But limestones occur in all geological formations—of whatever age ; the very earliest contain animal remains which tell that they were formed in the sea but their minute structure has suffered defacement at the hand of time and we cannot always trace them to their origin.

But what is limestone ; of what is it made ? Bred out of sea water by minute organisms—surely it is a material deserving our careful study ; and it invites attention from so many points of view.

The farmer, guided by that shrewd power of observation which he so often displays, has noted its agricultural value. Walk along the chalk downs, say in the Isle of Wight: note how frequently quarries occur abutting on the clay or sandy lands bordering the ridge: to what end has so much chalk been dug out—in the past, we must suppose, as the signs of recent removal are few? On inquiry we learn that it was once the custom to spread chalk on such lands and with great advantage to the crops: but of late years the practice is deemed too expensive by most farmers.

Here and there in all limestone districts, kilns are to be found in which the stone is burnt into lime—and lime confronts us everywhere in admixture with sand, as mortar. Whitening, which is simply very finely ground soft chalk washed free from all gritty matter and dirt, is used all the world over in making whitewash, whilst when mixed with oil it forms putty. We have some reason to be grateful to the *Globigerina*, therefore, for producing so universally useful a material as chalk. But it is a substance which sometimes makes itself awkward. There are few districts in which the water does not contain more or less dissolved limestone, being thereby rendered hard, as it is termed; such hard water, we know, is less suitable than rain water for washing purposes and is often productive of considerable difficulty when used in steam boilers.

How is such a substance to be dealt with to discover its nature—is no clue to be found by considering what is commonly known about it?

A man's character is not to be found out by merely looking at him: his actions must be studied. To determine the character of a substance, its capabilities must be inquired into. Everyone knows that limestone gives lime when burnt—the name implies as much. Some profound change must be involved—the lime is so very different from the limestone. On the Kentish coast but a few miles away, twice during every twenty-four hours, the chalk cliffs are wetted by the waves—yet nothing happens. But every bricklayer's labourer who is called upon to make mortar has learnt the trick of reducing lime to the finest of powders without any effort to himself—by merely pitching a pailful or two of water upon it: the man who made the observation originally and applied his discovery in practice must have been a transcendent genius; he scarcely

wore trousers but had he done so he would have realised that he could put his hands quietly into his pockets and look on at the water doing his work for him and doing it far more effectively than he could himself. Yet the beauty of the process is rarely appreciated. Carry it out for yourselves and see what happens. The water is greedily absorbed: then, after a time, the wetted lime grows hot, clouds of vapour are given off—and gradually the lumps fall into an impalpable dry powder, riven in every direction by the expansive force of the steam.

The lime is said to be slack or slaked—its thirst is satisfied: but where does the water go; how is so marvellous a change to be explained? The time should be near at hand when even the bricklayer's labourer will ask such questions—I trust many of you take real interest in the spectacle and desire to understand what has happened? If I ask you to suggest some means of finding out, what will you answer? I fancy someone says—"Make sure that the water really is all expelled: weigh the lime, then pour a known quantity of water upon it, let it slake and weigh the dry powder—don't work in a bricklayer's empirical fashion but be scientific—control all your actions by weighing and measuring." Good—such advice is worth following; with very little trouble we find that although some of the water is driven off as steam, much of it remains with the lime—the weight increasing by about one-third. It is thus discovered that lime has a great affection for water—but the union is marked by considerable display of temper, by heat. Was the lime in the limestone—if so how was its affection for water masked—what happened in the burning to confer so powerful a thirst upon it? Let us again be scientific and watch the limestone burning with the aid of the balance—the man in charge of the lime kiln tells us that the lime produced always weighs less than the limestone which is burnt. Taking whitening, as being the cleanest form of limestone procurable, on burning it in a crucible in a gas muffle furnace until it no longer changes in weight, it loses slightly less than 44 per cent., leaving about 56 per cent. of lime; however often the experiment be repeated with the whitening the result is always practically the same but different limestones give different results according as they contain more or less clay or grit. Assuming that the lime is precontained in the limestone, it would seem

that unless it be in some way destroyed, 43 to 44 per cent. of the whitening is driven off as thin air—since there is no visible smoke such as would be noticeable if a condensible substance were expelled.

I have chosen these two simple examples as illustrations of the way in which with a little care and consideration you can make use of ordinary commonplace but suggestive occurrences as arguments in devising experiments, with the object of solving problems relating to common objects and common phenomena. Our scientific method of working is nothing but commonsense writ large, systematically applied to practice.

But this by way of parenthesis. We are only beginning to understand limestone—let us look further into its doings ; it seems to be full of interest.

In limestone districts, where hard water prevails, people know quite well that there is often a deposit from such water when it is kept in the water bottles in hot weather and that invariably a crust is formed in the kettles and boilers in which it is heated. It is said vaguely that the water contains lime and such deposits are often referred to as lime out of the water. In most households it is known that although the deposit from the water sticks hard to a bottle and cannot be simply washed out, it is easily removed by acid, even by vinegar. Is it right to speak of a natural water as containing lime—how comes it that acid removes the deposit referred to ? Surely such questions may be answered by a few simple experiments—the solubility of lime is easily contrasted with that of limestone, their comparative behaviour with acids easily examined. It turns out that lime is much the more soluble in water and that limestone is scarcely soluble at all, to a far smaller extent than will account for the amount of solid dissolved in hard waters ; the solution of lime is quite unlike any ordinary water, peculiar in taste and in many other ways. Acids are found to dissolve both lime and limestone with extraordinary ease but to affect them very differently, the former disappearing quietly although the liquid becomes very hot, whilst the latter disappears with much spluttering and fizzing up : something being forced out from the seething mass. It is easily ascertained that a gas is given off. A prudent man desires to know how much money he spends—to know merely that his cash balance is diminishing is not enough : the scientific inquirer will not be satisfied with the observation that

something escapes on dissolving the limestone in acid but will question how much. It is as easy as not to make the experiment in such a manner that it affords rough quantitative results. The loss in repeated trials with whitening amounts to from 42 to 43 per cent. on the amount of the limestone dissolved.

The habit of putting two and two together is the one before all others to be acquired. Thinking back, we remember that the limestone lost about 44 per cent. in weight when burnt—now we find that it apparently loses nearly as much when dissolved in acid : is this a mere coincidence or has the resemblance a deeper meaning ? We have no proof as yet that lime is precontained in limestone—none that the gas comes from the limestone alone : but it is at least conceivable that the loss which it suffers when burnt is due to the gas which is given off when the stone is dissolved in acid and which may be collected easily. The conclusion is a legitimate one from the facts—it is at least a sound provisional working hypothesis. How shall we attempt to demonstrate its truth ? Obviously, if by bringing together lime and the gas which is given off when limestone is dissolved in acid we can produce a material having the properties of limestone, we shall have verified the hypothesis and solved the problem as to the nature of limestone-stuff. This turned out to be easy of accomplishment—on merely exposing lime in a vessel full of the gas, it gains in weight just up to the point required on the assumption that it is converted into limestone-stuff, at the same time it acquires all the properties of this material while losing those of lime. Sherlock Holmes could do no more ! Or, arguing from the fact that lime is so much more soluble than limestone, we may pass the gas into a solution of lime in water : soon a solid falls out—a precipitate we call it—as we should expect would be the case if the gas were to unite with the lime in solution. Having carried out the experiment on a scale such that two or three grams of the product are available, it is possible to ascertain what weight of lime it yields when burnt and what amount of gas is given off when it is dissolved in acid—and so to characterise it as chalk-stuff* : for the mere appearance of the precipitate proves nothing.

* Objection has more than once been taken to the use of expressions such as chalk-stuff or limestone-stuff and chalk or limestone-stuff gas ; nevertheless I continue to use them and do so advisedly. Chalk and limestone are

And proceeding in this way, discovery follows discovery : even carelessness sometimes has its place. Thus, when through an oversight or forgetfulness perhaps the gas is passed into the lime water during some considerable time, the precipitate seems to lessen instead of increasing in amount, as if it were soluble in presence of the gas. Does not such an observation serve to recall the fact that natural water sometimes contains an inexplicably large amount of what appears to be limestone-stuff ? Now, we can take water such as is available in this district and ascertain whether the solid which is deposited on boiling it is in reality limestone-stuff : but will it not be well first to boil the solution prepared by passing the gas into the lime water, to see how it behaves. It soon appears that it behaves like a natural hard water. On the other hand, the deposit from a hard water—the fur from a kettle or boiler—behaves exactly like limestone when burnt and towards acids. May we not therefore also expect that the hard water will contain the limestone-stuff gas ? As soon as the idea that such may be the case is evoked in our minds, it occurs to us—since the limestone-stuff is deposited on boiling the water—to boil hard water and pass the steam into lime water : a precipitate soon appears and we can therefore write Q.E.D.—as at the conclusion of an exercise in geometry. The gas is obviously soluble in water ; we take boiled water which is not rendered turbid by lime water and pass in the gas—lo and behold, on adding lime water the precipitate appears. But the deposit forms in water bottles without the water being heated : may we not therefore infer that the solution of the gas in water is an unstable one—may we not expect to find the gas in the air ? Does not this question recall to our recollection the

not definite substances but species of natural material which, if destroyed, cannot be reproduced ; the names have a definite geological connotation but no chemical meaning. The varieties of limestone are composed of a definite substance in greater or less proportion ; to call this substance at once by its recognised scientific name, when the game of an inquiry into its nature is being played, is simply to give away the game entirely from the outset and make it a worthless one to play from the point of view from which alone the game is worth playing—as a means of gaining knowledge of method. Let me urge that provisional names must be used throughout every inquiry. Stuff is an honest old English word of which far too little use is now made—probably if I had called the gas *Gypsogen* little objection would have been raised ; but it is difficult to be rational in these modern times.

fact that when we have carelessly left clear lime water exposed to the air a deposit has collected on the surface ? Does not this serve to suggest the experiment of exposing a considerable quantity of lime water to air so as to obtain sufficient solid for examination ? When the experiment is made, sufficient solid having been obtained and examined, we soon satisfy ourselves that it is chalk-stuff : consequently that air does contain the gas, although in relatively small amount.

But the magic circle is not yet complete. We speak of lime as made by burning limestone ; is this correct—do we burn it as we burn wood and coals and other things ? You reply, “ Perhaps not ; we can kindle wood and coal and when once on fire they continue to burn—limestone will not take fire ; it is baked rather than burnt.” We have learnt that it is simply resolved into two other materials by this baking—what becomes of wood and coal when burnt ? Seemingly they are destroyed—but has not our experience with limestone taught us to be careful : that disappearance does not necessarily mean destruction ? What do we know of the burning of coal—what does every cook know ? Why do we poke the fire—why is a chimney provided to the fireplace ? We know that air must have access to the kindled coal—that one function of the chimney is to cause a draught ; everyone knows the effect of so holding a newspaper as to close the opening above the grate and force the air to pass rapidly over the burning coal. Clearly the air is in some way necessary and promotes the burning. Such an argument as this would lead to an experiment being made to ascertain what happens to the air when things burn in it and ultimately to the discovery that air consists to the extent of about one-fifth of a gas which has an extraordinary affection for all combustible substances, just as water and the gas set free from limestone by acids have for lime : when this constituent of air and a combustible substance meet under appropriate conditions, they contract a firm union with great display of warmth : the products of such unions vary much in character, some being solid, some liquid and some gaseous ; some few are neutral like water, some are alkaline like lime and soda, whilst others are acid. The gas is named *Sour-stuff*, because when the part which it plays in combustion first came to be understood, the substances with which the experiments were

made happened to be such as gave rise to acids. The Germans, who are direct simple folk, call the gas to the present day Sour-stuff; the stuff which makes sour things; so do we, without knowing it, as—following the lead of the French—we use the Greek equivalent Oxygen: but having so long enjoyed the advantages of an exclusively classical education, we no longer attempt to apply our knowledge and so use the word without thought and without being reminded of its significance.

When coal or wood, indeed anything of vegetable or animal origin, is burnt, it is seemingly destroyed—that it takes wings to itself and dissolves into thin air is the discovery of but little more than a century. The winged product we know is the gas imprisoned in limestone, called by Black—who was the first to recognise its individuality—on this account, *Fixed air*, now known in our technical jargon as Carbon Dioxide, the compound which gives rise when joined to water to the very weak and unstable acid, Carbonic acid. To the instructed ear, these two names carry oceans of meaning: if you know how the expression *dioxide* is arrived at you are acquainted with the theoretical basis—the molecular-atomic theory—on which chemistry rests. But when acids are mentioned always think of sour-stuff—oxygen is *par excellence* the acid-giving element; the text books may tell you of hydrogen as characteristic of acids and even mislead you into a temporary belief in non-existent nonsensities called hydrogen ions: trust them not but pin your faith to oxygen; learn to think of oxygen as the most wonderful element known to us, and water as containing it in perhaps its most active form; at the same time, bear in mind that it has not only an acid aspect but is also the progenitor of earths. Iron, you know, is converted only too easily into the earthy substance iron-rust by combination with atmospheric oxygen under the conjoint influence of liquid water and carbonic acid—hence the need of protecting it by paint or of keeping it in a dry, warm place. At the smithy forge, iron and oxygen burn together into a brittle black scale—again an earthy substance. Those who have played with magnesium know that it not only burns brilliantly but that it is converted into a white earth. Zinc is systematically burnt to form Zinc oxide which is largely used as the basis of white paint. Both magnesium and zinc oxide look like lime and the former tastes like lime: whence

Brer Rabbit—who argued, you will remember, that what looked like Sparrer Grass and tasted like Sparrer Grass was Sparrer Grass—would say they are limes or earths and *vice versa* that an earth like lime must belong to the oxides. This kind of argument has in fact led chemists—led Humphrey Davy—to discover that lime is the oxide of a metal much like magnesium.

Just think what is got out of limestone by considered argument and measured study ! Itself a neutral substance, a typical salt, it is resolved into two typical oxides—an acidic oxide and an earthy, alkylic oxide. In deciphering its story, you may learn almost all that is necessary for any agriculturist to learn of chemical method. I say this because I feel that it in no way receives the attention it deserves—because it is one of the substances which should always live in your thoughts.

Ordinarily it is neglected, scarce seen ; the attempt is rarely made really to decipher its unobtrusive mysteries :—

The world is too much with us ; late and soon,
Getting and spending, we lay waste our powers ;
Little we see in Nature that is ours ;

. . . for everything we are out of tune ;
It moves us not.

Colleges such as this are intended to remedy the state of things complained of by the poet, to attune their students to a real appreciation of Nature : your gain will be in proportion to the extent to which you avail yourselves of the multitude of opportunities the College affords for the study of method and the cultivation of the faculty of insight.

Let me now touch on some of the problems which should come under your notice on the vital side. The amount of carbon dioxide in our atmosphere is but three parts in ten thousand—yet this is the whole trading capital of the agriculturist the wide world over. That so much can be made of so little is very wonderful ; and when we learn something of the mechanism by which Nature effects her purpose, it borders on the miraculous. Watching on a sunny day in spring the quivering leaves in a woodland district or the waving blades in a wheat field, we may well fancy that we are contemplating an ideal state of lazy enjoyment : the forces at work, the

ceaseless activity of the leaf surfaces, are in no way apparent. The plant is thought of merely as growing. Oliver Wendell Holmes' beautiful lines—

. . . God has made
This world a strife of atoms and of spheres ;
With every breath I sigh myself away
And take my tribute from the wandering wind
To fan the flame of life's consuming fire,

are not only descriptive of the process of animal respiration regarded as a destructive process but also of plant respiration regarded as a constructive process—tribute being taken by the plant from the wandering wind of its 3–10,000 of carbon-containing gas as well as of a certain modicum of oxygen.

It is taught in the schools that under the influence of sunlight and with the assistance of the green colouring matter, the carbon dioxide which the plant inhales is resolved into carbon which is retained and oxygen which escapes. The warmth displayed and dissipated when carbon and oxygen unite must in some way be recovered and restored to the system : the sun affords the necessary energy and hence it is that we regard vegetable matter as bottled up sunshine. At present, the nature of the initial process is entirely unknown to us and we can only form very general ideas as to the changes which supervene. Personally, I incline to the view that it will eventually be recognised that carbon dioxide is only indirectly deprived of its oxygen : it seems to me probable that water undergoes electrolysis under the influence of light and chlorophyll and that whilst oxygen is evolved, hydrogen becomes attached to the chlorophyll, subsequently acting on carbonic acid as a reducing agent and converting it into formic acid and then into formaldehyde. The evidence that this aldehyde is the primary material with which the plant works is almost overwhelming.

From this point onwards, change undoubtedly proceeds to some extent as in the laboratory but mainly along lines which require us to assume that directive forces are at work : the chief substances elaborated, the carbohydrates (sugars, starch, etc.), and the albuminoids or proteins, also the essential oils and alkaloids, are all optically active substances.

The significance of this circumstance can be appreciated only when certain geometrical considerations are understood. The carbon atom has the power of combining with four other atoms or groups of atoms ; a compound in which four different systems are associated with a carbon atom may be symbolised by a four-sided prism or tetrahedron. Two such models may be constructed—you can make them easily from cardboard—in which the systems are arranged in a different order, so that the one is to the other what an object is to its reflected image or a right hand to a left hand glove—such models will not fit over one another and are said to be without a plane of symmetry, as they cannot be divided into halves. A carbon atom in such a condition is termed *asymmetric*. All asymmetric compounds have the remarkable property of deflecting polarised light—hence they are said to be optically active. Whenever substances containing asymmetric carbon are produced artificially from inactive material the two forms of opposite but equal activity are always produced in equal proportions—the one form turning polarised rays to the right, the other turning them to the left, to equal extents although in opposite directions ; the product is therefore optically inert, as the equal opposite activities of the two forms neutralise one another. If change took place in the plant in the same way as in the laboratory, it is to be expected that mixtures in equal proportions of the two optically active forms of each particular compound would be produced. As a matter of fact, the carbohydrates are of one series only—the dextro series ; at one time, it was thought that perhaps these alone were preserved and that the plant, for its own purposes, made use of and destroyed those of the other series ; but of late years this conception has given place to the idea that only members of the one series are formed : in other words, that the course of change is so directed that only d-glucose and compounds derived therefrom are built up. The nature of the directive force is even surmised.

In plants as well as in animals, the digestion of the more complex compounds such as starch, the biose sugars and the albuminoids—that is to say, their simplification and assimilation—takes place under the influence of enzymes. These enzymes are kittle folk to deal with ; at present, we are quite unaware of their precise nature, as they cannot be separated in a state of purity and are very

easily destroyed. One of the most typical is the *diastase* of malt, which is present in all cereal grains and in green leaves; this enzyme acts on starch alone, converting it into soluble sugar (maltose). Invertase, which is present in most yeasts and in growing leaves, has the specific property of converting cane sugar into dextrose and levulose or fructose. In all cases, these enzymes act by promoting the hydrolysis of the compound affected—they, as it were, enforce the absorption of the elements of water and so determine the resolution of the compound into simpler substances. Their activity is altogether wonderful—a minute quantity sufficing gradually to transform a relatively large amount of the hydrolyte—*i.e.*, the compound hydrolysed. Although the effect they produce is similar to that produced by acids, they are distinguished from these by the fact that whereas the acids act indiscriminately and only with varying degrees of readiness, the enzymes act selectively—a given enzyme acting only on a particular compound or related series of compounds. The only rational explanation yet given of this specialised behaviour is that the enzyme and hydrolyte are compatible substances—that one is in some way built to fit the other; the closest approach to a picture of the manner in which an enzyme acts is afforded by a Geometer caterpillar clasping a twig with its many legs while it bites away the adjacent leaf edge with its mouth: we may think of an enzyme as clinging to its compatible hydrolyte and presenting water at the appropriate centre at which the resolution of the complex molecule is to be effected.

Supposing the enzyme or something very near to it were to preside at the birth of the compound, acting after the manner of the last upon which the shoemaker makes the shoe, we have a picture which probably is not far removed from that which would be revealed to us could we see the process at work in plant and animal—the directive agency—the outcome of which is the formation of one particular type of asymmetric compound.

Such in brief appears to be the philosophy both of progressive and of retrogressive change in plant and animal.

Questions of extraordinary interest and importance centre around the problem of the origin of the nitrogenous constituents of plants, especially of the albuminoids or proteins. First comes the question of the supply of nitrogen to plants. As you know, in

practice, this takes the form either of ammonia salts or of nitrates or of vegetable or animal matter containing assimilated nitrogen : in whatever form it be supplied, however, there is reason to suppose that it comes into action in the form of nitrate. The ammonia of ammonia salts and the ammonia derived from nitrogenous organic matters by their decay—apparently under the influence of organisms in the soil—undergoes oxidation within the soil at the instance of nitrifying bacteria ; it does not seem to be available directly. Possibly, nay probably, the nitrate undergoes reduction within the plant into hydroxylamine. But in the case of leguminous plants, a marvellous symbiotic mechanism is come into existence, whereby the plant is enabled to utilise nitrogen derived from the atmosphere : you probably know that nodular growths form upon the roots and that in these bacteria abide, which, we believe, are the active assimilating agents. From a chemical point of view, the whole process is most mysterious and marvellous : but there is no problem in agriculture which is so important a one to solve in the interest of future generations. Our stores of ammonia and of nitrates are rapidly being depleted—it is scarcely probable that the methods of making these substances artificially will satisfy the demand that must arise in the future : a great extension of the natural process of accumulating nitrogen from the atmosphere is therefore to be desired.

As the albuminoids, like the carbohydrates, are all optically active and apparently members of one class, it is not improbable that their genesis is in some way bound up with that of the carbohydrates : the process is certainly a directed process and perhaps they also are constructed on an enzymic model or last.

Hitherto, little attention has been paid to the production of quality, in the chemical sense, either in plants or animals : quantity and certain characteristics have mainly been in demand. Now, we are beginning to realise that quality must be attended to—that we know little or nothing at present, except empirically, of our own requirements and still less of those of agricultural stock. Man has just felt his way by picking and choosing and reason has played but a small part in determining his choice of food. The time is at hand when in feeding ourselves and our stock we must be guided more by scientific principles.

Food is of value to animals from two points of view—as the source of energy and as constructive material. It is only of value in so far as it is digestible—that is to say, in so far as the enzymes are at our disposal which are capable of taking its complex constituents to pieces and rendering them soluble and transmissible to various parts of the body. The carbohydrates are of value mainly as fuel—they are required in relatively small quantity as constructive materials.

The function of the albuminoids or proteins as constructive materials is clear—that they serve also as fuel cannot be doubted ; but we have little idea at present to what extent they are necessary, if at all, as the source of energy. The animal mechanism is of extraordinary complexity—its parts differ much in composition being constructed of very different nitrogenous materials ; and there are also great differences between the nitrogenous materials of different origin whether animal or vegetable.

We may compare the digestion of food with the pulling down of a building by housebreakers. Not long ago it was supposed that digestion—at least in its earlier stages—involved the breaking down of the complex albuminoid structures into a few simpler but at the same time still complex sub-groups ; and that these were then assimilated and reunited to form the animal tissue. This view has given place of late to the idea that the simplification of the albuminoids is carried very far—in fact down to the ultimate units, such as leucine, tyrosine, etc. ; it is supposed that the tissues are reconstructed from these very simple materials.

The albuminoids generally may be contrasted with buildings which not only differ in construction but which—when taken to pieces—turn out to be made of bricks of very different sizes and shapes, perhaps twenty or more ; and not only so, for the different buildings are found to contain the different sized bricks in different proportions. This point is a very important one. To give an illustration : wheat gluten on digestion yields about a third of its weight of a particular amino-acid—glutaminic acid—which is quite a minor constituent of most animal albuminoids. What becomes of this particular kind of brick—of this particular product of animal digestion—when flour is consumed by us ? It is certainly only partially assimilated ; but before the unassimilated portion can

escape from the body, it must be completely burnt up. The value of flour as food must depend on whether it is burnt up to a considerable extent usefully or merely in order that it may be got rid of it: if the latter be the case, work is thrown unnecessarily upon the organs which effect the change. *Per contra*, certain constituents of our food, present in very minute quantity, are nevertheless probably of utmost consequence as furnishing the necessary means of constructing some particular, all essential part of the animal mechanism—to supply the required amount of such material it may be necessary to consume considerable quantities of the ordinary foods: the use of a more concentrated form of the material would presumably be of great advantage. Until questions such as these are solved, stock raising and the maintenance of health must be subject to purely empirical rules. Some of you will know that there has been considerable discussion of late on the nutritive value of various kinds of bread and on the selection of seed calculated to give a good wheat. Probably the discussion is entirely premature—we simply do not know what constitutes a good wheat; there is no accepted standard of goodness. What is called strength is a purely fictitious expression with regard to the food value of flour: it has reference merely to the power of the flour to carry water and to its stickiness, the “strongest” flour being one from which the baker can make the greatest number of loaves, and the biggest loaf; it is therefore the weakest as a food material.

While the office of nitrogenous manures as contributing a necessary material to the formation of albuminoids and that of phosphates as contributing to the formation of nuclear elements can be understood, that of the third mineral substance necessary for plant growth—potash—is at present veiled in mystery. It is only clear that in some way both potash and phosphate play an all important part in the production of sugars and starch. Most plants are pronounced gypsophilists and lime is taken up in considerable amount by some plants. The importance of limestone as a regular constituent of soils is scarcely appreciated as yet by agriculturists: the results attending the exhaustion of the soil of this constituent as a consequence of the repeated application of ammonia salts are now only beginning to attract attention.

I trust that what I have said will lead you to see that it is a substance worthy of your most serious attention at all times.

In terminating this address, let me point out the objects I have had in view. I want you to see how wonderful a field lies before you—if you will but learn to look into the heart of things. No career has greater opportunities than yours; none is lived under more favourable, more interesting conditions. The problems to be solved are innumerable and it is of infinite importance to the well being of mankind that many of them should be solved without delay. Nothing could be farther from the truth than to suppose that farming is played out—the opportunity of the agriculturist is but beginning to come. Pursuing as he does one of the most difficult of businesses, the one profession which is indispensable to mankind, he should be among the most intelligent of workers.

But if you are to take advantage of your opportunities, you must be strenuous workers while at College here. Do not be too anxious to accumulate mere knowledge of facts but do everything you can to learn to think for yourselves and to help yourselves: cultivate your powers of observation; devote yourselves as far as possible to the study of method. In my earlier remarks, I have sought to indicate the way in which a simple inquiry may be conducted: perhaps when you think over my remarks they will be helpful to you and lead you to see the need of a motive for every act and the way in which motives arise almost spontaneously—when they are looked for.

The danger you have most to guard against will be that of allowing yourselves to be taught dogmatically: text-books are pernicious company unless you learn to read them critically, to consider and question their every statement, to inquire into the methods and understand the train of reasoning which have led to the conclusions you are asked to accept. On no account confine your attention to text books—do all you can to acquire the art of consulting larger books and especially original memoirs: it is not easily gained. Two books I would specially recommend to your notice in connection with the earlier part of my address—Kingsley's "Town Geology," a shilling edition of which has recently been published by Messrs. Macmillan; and Black's Experiments

on Magnesia Alba, Quick Lime, etc. (1755)—one of the Alembic Club reprints (1s. 6d.), published by Simpkin, Marshall & Co.

The former not only contains interesting matter but is valuable on account of its arguments ; the latter is one of the few classics we have in Chemistry : no book deserves more careful attention at the hands of the student of scientific method.

In my later remarks, I have dealt very briefly with some of the more important problems which should claim your attention. They are subjects to which you should give special consideration. The field covered by the sciences which bear upon agriculture is so wide that some limitation must be made if you are to study effectively ; but let me urge you not to take too narrow a view of your requirements.

The men who go from this College should be the future leaders of agriculture throughout our empire ; they must be trained broadly and thoroughly : only those will be worthy to serve as guides who become imbued with the spirit of research while here. If you will but work with the earnestness I have advocated, you will learn to appreciate the difficulties as well as the opportunities which must attend agricultural inquiry : the conditions, as a rule, are so complex that the necessary insight is only to be obtained by the most patient and prolonged investigation.

In an empire such as ours, the problems awaiting attack are extraordinary in their variety and such as to tax in a high degree the powers of all who attempt their solution. When in the United States, I have been struck, as everyone is, by the wonderful care and precision with which inquiry is organised and prosecuted in every possible direction—by the Agricultural Bureau in Washington ; the far reaching influence which the Bureau is exercising on the agricultural community is altogether remarkable. I am lost in amazement at the supineness of our authorities and at the failure of our public to appreciate the immensity of the interests at stake. At present, we do little more than drift along : no organised attack is being made even on problems of urgency.

Efforts such as are being made in this College are therefore all the more praiseworthy—but students need to realise how great a burden is cast upon them if they are to live up to their opportunities, in order that they may in the end achieve for Agriculture

the recognition and respect it merits as the one necessary industry of the world during all time : the sole connecting link between us and the far distant luminary which is the mainspring of all vital activity upon the earth—

. . . The great sun,
Girt with his mantle of tempestuous flame,
Glares in mid-heaven ; but to his noontide blaze
The slender violet lifts its lidless eye
And from his splendour steals its fairest hue,
Its sweetest perfume from his scorching fire.

PRIZE DISTRIBUTION DAY.

In the unavoidable absence of the Right Hon. Earl Carrington, G.C.M.G., the Minister for Agriculture, Lady Carrington visited the College on Wednesday, July 18th, for the purpose of distributing the prizes to the successful students and declaring open the buildings which have been added to the College.

The new buildings comprise a spacious gymnasium, sixty-three feet by twenty-four feet, the gift of an anonymous donor, which will also be utilised for gatherings of various kinds ; an up-to-date shoeing forge, in which the students are also taught the repair of machinery ; a well-equipped joiners' shop, new offices, a room to be known as the " Halsey Memorial Drawing Office," for surveying and building construction ; a laboratory for research in botanical work ; a bacteriological laboratory, and an apartment set apart for research in chemistry and analysis of soils. The whole of the above are either new or additions to the accommodation of a more or less limited character previously provided.

A numerous company attended the prize giving. The Principal (Mr. M. J. R. Dunstan), presided, Lady Carrington occupying a seat on his right together with Major Craigie, C.B. (representing the Board of Agriculture). On his left were Lord Ashcombe (Chairman of the Governors), Mr. George Marsham (Vice-chairman of the Governors and Chairman of the Kent County Council). Mr. Lawrence Hardy, M.P., Dr. Frank Clowes (Governor), Mr. A. Amos (Governor), Mr. Ramsay Nares, Secretary to the Surrey

Education Committee and Mr. J. Turner Welldon, Clerk to the Governors. Among others present were Mr. C. Burt, C.A. (Richmond), the Rev. Canon Tindall (Ashford), the Rev. W. Henry, Mr. G. F. Deedes, Col. Hay, the Rev. T. G. Hall, Rev. S. H. Rendall, Col. Cheesman, General West, Capt. Reid, Rev. T. P. Hiron, Col. Bromhead, Major Neve, Lieut.-Col. Honeyball, Rev. W. C. Compton (Dover), Col. McKinstry (Chelsea), Col. Bruce (Folkestone), Col. Campbell, Capt. Down, Capt. Somerset-Webb, Capt. Baldwin, Rev. W. B. Drawbridge, Rev. W. G. Elnor, Rev. J. A. Halloran, Messrs. W. Garrad (Bures), G. Beale Pinyon, H. F. Plumptre, F. Rothwell (Milford), W. W. Knight, W. J. Mason (Surbiton), E. A. Harbord (London), J. F. Twinberrow (Worcester), C. H. Goodman, J. H. Sherwin, W. Broadley, G. Mallion, F. K. Beazley (Enfield), R. Mercer, J. Byron, Dr. C. Tilbury Fox, Messrs. E. T. Scammell (Representing Agent-General for West Australia), H. S. Buss, Dee Swaffer, J. M. Poncia, Dr. E. Colville, Messrs. W. H. Hammond, J. Dungey, H. L. Cooper (Broxbourne), J. Harvey, A. J. Spencer (Wallington), L. Ashbee, G. Furley, H. H. Mount, E. S. Goodson, J. S. Swinnock (Margate), A. Brown, B. Noakes (London), F. Amos, F. J. Neame, J. E. Herbert, W. S. Harnett, H. E. H. Rice (Dover), W. E. S. Erle-Drax, R. J. Sankey (East Croydon), R. Amos, H. S. Wainwright, F. R. Bourne, T. W. Knowles (Campden), Dr. C. Wickham, Messrs. A. J. Burrows, A. Miskin, A. G. Hendry (Ramsgate), H. Amos, W. Quin (New Zealand), R. H. Green, E. W. Amos, J. D. Maxted, C. Bates, A. W. Hurley, W. W. Blest, F. de B. Collard, W. R. Harvey, F. E. Wallis (Maidstone), T. D. Moss crop, T. R. Todd, T. Iremonger (London), Ed. le May, E. Kingsland, Cardross Grant (Beckenham), E. Leney, E. Lord, F. Maylam, W. H. Hilton, G. Ellen, R. Tanner, J. Lowes, W. H. Watson (Sevenoaks), H. Carman, W. H. Crowhurst, G. F. Whiteman, E. Barton, H. Hordern, C. E. Cutbill, A. Downs, E. Fowler, S. Wells, A. Birt, H. J. Butler, S. Thirkell, G. Jeken, C. Moon (Surbiton), J. W. Wood, C. Maylam, W. Pickering, C. Smith (Maidstone), G. Woodgate, E. S. Butcher, J. G. Benton.

The Chairman, having expressed regret at the absence of Lord Carrington, and cordially welcomed Lady Carrington among them, said his first duty was to ask Lady Carrington to open the new

buildings, which had been erected owing to the great expansion of the College, and the increase in the number of students, both very satisfactory things. Public institutions supported by public money were apt not to receive assistance from private benefactors, and it was a very delightful fact that they should owe the Gymnasium in which they were seated to the generosity of an anonymous donor. The drawing office had also been erected by an anonymous donor, and were in memory of the late Mr. E. J. Halsey (applause). Although the College wanted no further evidence of Mr. Halsey's work in connection with it, it showed the kindly and generous feelings which had prompted this anonymous donor to perpetuate his memory, and this room would in future be known as the Halsey Drawing Office. With regard to the College he had nothing but progress to report. The number of students was 101, and this constituted a record. But they could not measure the prospects of Wye by the number of heads only (hear, hear). The highest work the students did was represented by the reputations they earned when they went out in the world, and nothing could be more satisfactory than the record of students who had left the College. With regard to agriculture, he had been called a cheery optimist, but he did believe there was still in this country an opening for a living for any well-informed and hard-working young man careful in the business of the farm. They looked forward to greatly developing the college, so that it would be of economic value to the farmer, and he was assured that the development of the research side of the work at the College would not only effect this object, but would add to their knowledge of agricultural science (applause).

Lady Carrington then declared the building open, and afterwards distributed the certificates and prizes.

PRIZES :—

Second year—Agriculture, R. N. Dowling ; *prox.* G. Fenoulhet. Agricultural Botany, R. N. Dowling ; *prox.* C. J. Sherwin. Agricultural Chemistry, R. N. Dowling and G. Fenoulhet equal. Surveying, E. O. Greening ; *prox.* C. J. Sherwin. Estate Management, E. T. Bruce ; *prox.* C. B. Saunders. Special Certificate Prize, H. G. Crumplin.

First year—Agriculture, G. B. Pinyon and H. Tonks equal.
General Science, G. B. Pinyon ; *prox.* R. H. Carter.

MEDALS :—

Design for Farm Buildings, A. D. McKinstry ; very highly commended, E. O. Greening.

Collection of Botanical and Entomological Specimens, R. N. Dowling and F. P. Jepson.

Poultry Medal, kindly presented by R. H. Cooke, Esq., of Detling, Maidstone, S. Rothwell.

DIPLOMAS AND CERTIFICATES :—

Diplomas with Honours. Agriculture—G. H. Garrad and R. S. Vinson. Botany—C. W. Mason. Entomology—C. W. Mason and S. Rothwell. Surveying—E. T. Bruce and A. D. McKinstry.

Diplomas—R. N. Dowling, G. Fenoulhet, W. H. A. FitzRoy, E. O. Greening, F. P. Jepson, C. J. Sherwin, A. V. Spencer.

Certificates—J. H. Baldwin, H. G. Crumplin, and F. M. Goodson.

L. G. Gardner and C. W. Passingham, who were re-examined in December, 1905, obtained the Diploma, and J. F. H. Trueman the Certificate.

The following students satisfied the examiners in Part I. of the Diploma :—R. S. Biscoe, J. B. G. Burchett, R. H. Carter, T. Chuidian, G. H. Drummond, W. R. Dunlop, L. R. Eizaguirre, G. A. Goodman, W. N. Harvey, W. Hopkins, L. E. Knollys, G. B. Pinyon, V. Rawson, A. M. Ridley, H. Tonks, and F. H. Vaughan.

F. Blest, K. H. Beazley, B. H. Drawbridge, R. C. Cheesman, G. Harbord, S. F. Pearson, E. P. Morgan, E. W. Morrell and F. K. Willis passed Part I. of the Certificate.

The successes of Students in outside examinations were as follows :—

B.Sc. Agriculture—H. E. Annett.

National Diploma.—G. H. Garrad, J. F. Harrison, S. Rothwell and R. S. Vinson.

National Diploma, Part I.—R. N. Dowling, G. Fenoulhet, and A. D. McKinstry.

Surveyors' Institution Professional Examination.—A. Anderson, E. T. Bruce, A. G. Culme-Seymour, G. H. Garrad, and A. D. McKinstry.

Two former students, A. B. Pritchard and J. P. Woodhams passed the qualifying examination for the Fellowship.

Lord Ashcombe moved a vote of thanks to Lady Carrington for her presence, and said it was a matter of great regret to them that his important duties in London had prevented Lord Carrington from coming amongst them that day. He would like to take that opportunity of saying how great were the obligations the governors felt to the Principal and his staff, who so earnestly and cordially carried on the work of the College (applause). Those who had heard the Principal's address would know that the College was no place for those who were not earnest and hard working, and he trusted it would continue to hold the position it had already acquired.

Mr. Laurence Hardy, M.P., cordially seconded the motion.

Mr. Burt, C.A., supported the motion, which was carried unanimously, and acknowledged, on behalf of Lady Carrington, by Major Craigie, who promised to convey to his department a very favourable report of what he had seen that day (applause).

The proceedings then terminated.

SUMMER COURSE FOR TEACHERS.

The usual course for Kent and Surrey Teachers was held in August, sixty-eight teachers attending, of which number forty were from Kent and twenty-eight from Surrey; of these sixty-six were men and two were women.

As in the previous year the course was divided into Elementary and Advanced, the work devolving chiefly on the Botanical and Chemical departments. Other subjects included Entomology, Agriculture, Horticulture, Veterinary Science, Poultry and Bee-keeping.

Popular lectures were given on "A Mediæval Village," "The Making of the Flag," and "The Life in the Soil." A Botanical

and Geological Excursion was made to Richborough Castle, and the sea-coast near Sandwich, other afternoons being employed on the farm and gardens. Cricket, tennis, and rifle-shooting matches were arranged, and in the evenings there were concerts, etc.

FRUIT GROWERS' CONFERENCE.

A conference of fruit growers was held at the College on Wednesday, November 7th, at which interesting papers on planting and the treatment of diseases peculiar to fruit trees were given. The chair was occupied by Mr. Laurence Hardy, M.P., who was supported by the Principal of the College, Mr. M. J. R. Dunstan, M.A., Mr. F. V. Theobald, M.A., Vice-Principal, Mr. J. Sayer, Mr. S. U. Pickering, F.R.S., Mr. E. S. Salmon, F.L.S., and Mr. W. P. Wright, and amongst those who accepted invitations to attend were:—Messrs. E. Ascherson, F. Maylam, G. E. Norton, D. V. Strickland, L. Doubleday, W. Rogers, R. T. Vinson, H. Stonham, T. G. Barnes, P. Manwaring, Jas. Duncanson, Henry Terry, H. Amos, S. H. Hart, D. L. Seligman, H. J. Overy, E. Ledger, C. E. Cutbill, Henry Reader, John H. Burch, A. Kay, G. T. Burton, L. S. Gardener, W. C. Long, Lewis H. Page, E. Reader, Geo. Hilder, A. J. Butcher, H. Woodhams, H. Staples, E. S. Butcher, T. Lingham, Allen Bros., W. Miskin, W. G. Chandler, Wm. Body, H. G. Maxted, I. Stevens, R. J. Sankey, George Norris, W. V. Tabret, Henry Chapman, Thomas Scott, B. Champion, R. H. Green, Robert Amos, B. G. Berry, A. Vinson, Chas. E. Bass, J. Maxted, Geo. G. Champion, Wm. Chambers, H. Hughes, L. Ashbee, E. Fowler, J. F. Honeyball, F. Smith, W. W. Berry, S. Lee, F. Chambers, J. Edmonds, Charles Sutton, H. W. Wickham Hore, Geo. Mount, L. E. Humphreys, E. B. Gascoyne, K. Town Smith, H. L. Mills, T. Steers, C. S. Martin, Miss F. Wilkinson and Miss Villiers Stuart.

Mr. Hardy, in opening the proceedings, said they had met together for a conference upon the fruit question, and he wassure, speaking as the Parliamentary representative for this district, he might be allowed to welcome them on behalf of the College and on behalf of Kent, that they might take some part in what he

was sure was to all of them a most interesting subject. Some might say—Why come to the south-eastern corner of England to learn about fruit? But he thought people were apt to forget that Kent was the first county in fruit growing (applause). Some three hundred thousand acres in this country were under fruit cultivation, and of this acreage Kent had a large proportion and they therefore had some right to welcome them in Kent, and some right to take part in a fruit conference at Wye College, because it was the only State-aided College which gave attention to fruit culture and fruit research. The extent of the industry could be gathered from the fact that there were 300,000 acres, which gave it a proportion of one to four in comparison with wheat, and as Kent with five other counties in the west had three-fifths of the acreage of England under fruit cultivation, it showed the importance of the industry in this county. The committee which recently sat in connection with the fruit industry made forty recommendations, and although nothing had yet been done by Government, he was glad to see that some of the problems raised by that committee were to be dealt with by the lecturers that day. The points made by the committee were the insufficiency of knowledge as to the right kinds of fruit, the character of soil and the effect of manuring, pruning and treatment of the trees, and the diseases and insect pests and methods of combating them. He was glad to think public attention through the committee had been called to the fruit industry, and as one of the problems of bringing people back to the land, he would mention that they had evidence that from £20 to £25 per acre was spent on fruit cultivation every year, which with their present acreage gave over seven millions in labour in the country districts of England (applause).

Mr. Dunstan said it was always the object of the College and of the Governors that the College should be as useful as possible, and this had been proved by the appointment of Mr. Salmon, who had, he thought, readily justified his appointment by his energetic work in one or two departments. The external organisation of the industry was a point beyond the management of the College; that they would leave to the Fruit-growers' Federation and other co-operative associations. They considered details of scientific and practical interest, which were so vitally important

to the fruit-growing industry. The questions of variety and of planting were for the individual grower, but they hoped that growers would in the future, as in the past, come to the College for information, which it was almost impossible for them without breadth of inquiry and experience to obtain (applause).

METHODS OF PLANTING.

Mr. S. U. Pickering, F.R.S., Director of Ridgemount Experimental Fruit Farm, then gave his lecture on methods of planting. He explained that the experiments had extended over twelve years, and the total number of trees concerned in the experiment was nearly 1,000, and the results were obtained from six different soils in eight different counties. One of their first experiments was to find what would be the result of what was considered bad planting, and some apple trees were put in in untrenched ground, the roots huddled into a small hole and then stamped in. For the first year they showed by their growth a falling away from the average standard maintained by trees planted under the ordinary normal conditions, but after the first year or two the tendency was to improve, and at the end of three years the growth was above the average. What was the explanation. It was perhaps shown in a too deeply planted tree, which also grew well after three years, and on digging it to examine the roots he found that the original roots had died away, and new vigorous roots had formed higher up the stem. Of course it was recognised that to damage the tree in certain ways, such as pruning and root pruning, was done to benefit the tree, and it was possible that the solution here was that the old roots being damaged caused more vigorous ones to form, but it was a very difficult subject to deal with or to recommend action on, because the injury must be limited, and the extent of that limitation was difficult to define, for they would have the danger of the dead roots decaying and becoming a source of danger to the tree. But there was one item of practical utility which they might remember, and that was the stamping of the root into the ground. They then continued their experiments by planting in a small hole and ramming the roots down, and here the results obtained were

such that the growth of wood and of root were, with a few exceptions, in excess of the average standard which they had taken in some cases by nearly 100 per cent. Experiments of this nature had been made at Millbrook, Ridgemount, Harpenden, Hadenham (Cambs.), Holmes Chapel (Cheshire), Ross (Hereford), and Milton Abbott (Devon). At Holmes Chapel one group showed a decrease from the average, and at Millbrook, where the soil was a light sand, there was also a falling-off, but the average gain throughout the whole lot, as compared with the average growth, was 25 per cent, and this all in the first year.

Mr. E. Ascherson asked if it followed that greater growth of wood meant bigger crops of fruit. After all it was the fruit crop in which they were most concerned, and the methods at present followed advised the prevention of too much wood growth. Mr. Mount, of Canterbury, said it would appear that they had been following a system which was a wrong one, if the lecturer was right in his arguing from the experiments that it was best to plant in a small hole and puddle the roots. Personally; he could not accept it, and he had had a large experience of planting. He believed in careful spreading of the roots and in firm planting, by which he meant closing in the earth well round the roots, not on top of the ground. Mr. Dunstan said the paper was not intended to be a suggestion that the method dealt with was the correct one; Mr. Pickering merely gave the results of the experiments, and left the conclusions to be drawn. Mr. H. Amos said his experience of cherry tree planting was that they did not want putting into the earth at all. The roots should be spread on top, and additional earth put to them. Mr. Smith, of Loddington, thought the best thing was to prepare a very fine tilth. He thought that brought the earth into sufficiently close contact with the roots. Mr. Stevens, of Egerton, stated that as an experiment forty years ago, he and his brother planted three damson trees each. His own were put in in the ordinary way, but his brother trod each tree, so much so, that he thought they could not live. The result, however, was that those that were rammed were alive to-day, and the three he planted died off at once. Mr. Harvey, of Kennington, said it did not follow that if they got a lot of wood they would get a proportionate crop of fruit. He knew of some trees planted too deeply which had not

grown this last twenty years. Mr. Pickering, in reply, said that so far as his experiments went, the fruit produce was 30 per cent. above the average. He mentioned that he was strongly opposed to deep planting, and had only given the illustration as a possible solution of a result of ramming, which was not expected.

STRAWBERRY CULTURE.

Mr. W. P. Wright, Horticultural Superintendent Wye College, and Kent County Council, gave a lecture on strawberry culture. In dealing with varieties, he referred to the Royal Sovereign as the most prominent early, the Bedfordshire Champion as a good second, and Paxton's Latest as a good late variety. Other varieties mentioned were Reward, Laxton, Progress, Gibbon's Late Prolific, Garibaldi, Dr. Hogg, and Fill-basket. Mr. Wright dwelt at some length on the selection of the fruit for market, pointing out the necessity of one which would travel well, and the desirability of giving great attention to the packing. He showed two new punnetts which, being made of cardboard, and square, packed much more easily than the generally used round ones. He also showed some bottles in which fruit could be preserved in water only, and mentioned that if they could maintain the taste for fruit all the year round, the demand when the fruit itself was in season would be heavier than if the public could only get the fruit at one particular period of the year. This fact was evidenced by the importation of tomatoes almost all the year round, which, instead of injuring the English growers, had served as a stimulus to the demand, so that English growers did better now than before the introduction of foreign tomatoes. With regard to propagation, he advised the taking of the early runners and potting off, so that they might bear the next year, and the entire change of the bed after the third, or, at the most, the fourth year of produce. One of the audience said the reason of the deterioration of Sir Joseph Paxton was that the raisers did not take sufficient care in selecting the runners, while Mr. Pierce, of Canterbury, spoke highly of a new variety, the Kentish Favourite, which, he said, fetched 2s. a gallon more at Covent Garden than any other strawberry on the market last year. In reply to another query as to manure, Mr. Wright recommended

the use of good farmyard manure, with potash and superphosphate added.

Luncheon was then served, and, following the toast of The King, which was given by the Principal, Mr. Hardy proposed the College, coupled with the name of Mr. Dunstan (applause). He thanked the College for the generous hospitality accorded them, and the very excellent arrangements made for the conference, and for bringing up the subjects which were before the Conference. It was of great advantage to fruit growers to have an opportunity of meeting together to compare notes and to learn as much as possible from those who were devoting their lives to research in connection with fruit cultivation, and the diseases which might impede the trade (applause). Mr. Dunstan, in reply, said research often meant years of labour without much apparent result. Prof. Cave, in the veterinary department, was making researches into such difficult problems as that of struck sheep, and he hoped before many years that some definite information on this terrible disease, with perhaps a possible cure, would be forthcoming. Colonel Honeyball proposed the health of the Chairman, to which Mr. Hardy briefly responded.

THE WOOLLY APHIS.

On the conference resuming, Mr. F. V. Theobald read a paper on the Woolly Aphis. He said :—

The reason this insect pest is particularly referred to is on account of its steady increase during recent years, and the frequent complaints that it is found again sooner or later after it has been cleared off by various methods of treatment. The woolly aphis, called also the American Blight in this country, not only attacks the apple, but also the pear. It occurs over all Europe, Northern America, the Cape, Australia and New Zealand. In the past, distribution by nursery stock has played a prominent part. It is almost certain that by this means it has made its way to all the other countries in which it is found from its original home—Europe. It is also spread in this way in our country on the roots of young stock, and growers should guard against this by having the plants fumigated with hydrocyanic acid gas before planting. The damage

which it does directly to the trees is well-known, at least so far as one of its methods of attack go, namely, its working on shoots and stems. I feel convinced that indirectly it has also some evil effect for the tree, namely, as a preparer for the far worse fungoid disease, canker. In going over some fifteen years' notes on this subject, I find that over 90 per cent. of trees suffering from this insect attack, have had or actually have canker, and that trees which developed woolly aphid soon suffered from the fungus. Of course other related insects, such as the three apple aphides, no doubt have a similar tendency, but only one affects to any extent the shoots, and it is unlikely that leaf curling species would do so. On account then, not only of its recent increase, but also on account of its well-known damage above ground, its little known damage below, and its possible indirect connection with a totally different disease, I bring this subject before you for discussion to-day. From what we have seen of its life-history, we may summarise the following important facts :—(1) That like the phylloxera of the vine, it has a terrestrial (stem and shoot) generation, and also a subterranean generation on the roots. (2) That an active migration can and does take place between these root forms to the stem and *vice versa*. (3) That the aphid will continue to live in active condition on the stem and on the roots all the year, and that continuity of existence is kept up in that way to some extent. (4) That not always, but now and then, a sexual generation is produced in the autumn, and the sexual females deposit each one egg close to the base of the tree, and from these eggs, which remain on the trees all the winter, a new family is started in spring. (5) We have thus the woolly aphid in three forms in winter, hibernating in cracks and crevices in the bark as active insects, living on the roots, and in the egg stage. We thus see the difficulty of coping with it in winter. Treatment to be of any avail must be when we have it active on stem, shoots and roots. The stem and shoot form may be killed by a heavy washing with paraffin emulsion. This must be applied with force, and not as a mere spray which simply lodges on the wool the insects secrete. This is best done in late summer. At this time we have no egg stage. We have the root form, and this can easily be killed by the injection of bisulphide of carbon into the ground. The exact quantity will depend upon local circum-

stances—for small trees generally two ounces is enough, for a large cyder tree four. It may be injected by special machines into the soil. The only care necessary is that the fluid does not come in actual contact with the large roots. It is best injected two feet away from the trunk, one ounce in each hole made by the injector. It is necessary that the earth be quite dry. Spring or early summer treatment can be adopted, but the use of paraffin emulsion then is not recommended if we can in any way avoid it. I may state here that caustic alkali wash in its weakest proportions used will kill the hibernating stem form and does some good. The greatest strengths will not harm the eggs. It thus does not matter what grades of ingredients you use, except as a matter of cost, and the same may be said in relation to this wash for any other insect eggs. I may point out with very strong confidence that we must use the paraffin emulsion I have referred to at various strengths for various plants. For use on apple trees you can take as safe those recommended in the Board of Agriculture Leaflets.

In the course of the discussion which followed, Mr. Wood, of Swanley, said that last year he had fifty thousand fruit trees infested with the blight, and a treatment of methylated spirit had forced it down to the root. On Mr. Theobald's instruction he had treated the roots with cyanide of potassium, and there had been no return of American blight.

FUNGUS DISEASES OF ORCHARDS AND PLANTATIONS.

Mr. E. S. Salmon, mycologist at the College, then gave his lecture on "Some Fungus Diseases of Orchards and Plantations," which was illustrated with lantern slides showing photographs taken by Mr. W. H. Hammond, of Canterbury.

Mr. Salmon said that each fungus, according to its life history, became vulnerable at certain stages of its development, and it was then especially that the fruit-grower should step in and extirpate the pest. He had found that three fungus diseases above all others were causing great losses in the fruit plantations of Kent and Surrey, viz., Apple Scab or Black Spot, Brown Rot, and the Apple Powdery Mildew.

Apple Scab or Black Spot was known to most growers only on the apple itself ; the fungus which caused the disease, however, was very common on the leaves. If the leaves were kept clean by spraying, no "scabbed" fruit would occur. From the district of Maidstone he had received reports of plantations where for several years past the apples had been subject to "scab" in increasing quantity. In the case of some varieties, half of the entire crop was ruined for market purposes. On visiting these plantations he found a stage of the fungus inhabiting the young wood of the trees. The fungus inhabited the apple-tree all through the winter, and then in the spring scattered its spores on to the new leaves and young fruit, and so caused a fresh outbreak of "scab" each season. It was the wood of certain varieties only, however, which the fungus was able to attack. The grower must discover these, and then during winter spray the trees with a strong winter wash. Apple twigs suspected of harbouring "scab" could always be sent to the College for determination. Apple scab yielded easily to treatment. The systematic spraying of the leaves and young fruit with Bordeaux mixture, and, if necessary, of the older fruit with ammoniacal solution of copper carbonate, and the application of a winter wash of copper sulphate to any trees with diseased wood, would, if carried out during consecutive seasons, soon restore "scabby" plantations to perfect health.

The Brown Rot fungus attacked the cherry, plum, apple, pear, and peach indiscriminately, and caused probably a far greater amount of loss to the fruit-grower than any other fungus disease. Yet it was seldom recognised, the injury caused by the fungus being very generally attributed to the action of frost. It was characteristic of the present fungus to attack the tree when in flower. Often, when a tree is in full bloom the flowers here and there on a number of branches suddenly hang limp, then turn brown, and wither. On looking closely at these withered flowers, the minute grey spores of the fungus would be found. The "dying back" of branches was one of the first signs shown by a tree when attacked. The fruit was also virulently attacked ; this turned soft and became rotten, or frequently it dried up. If the mummified fruit were left to hang on the tree through the winter, the fungus produced on it, in the following spring, a fresh crop of spores. By

adopting preventive measures, viz., the collection and burning of "mummified" fruits, and as much dead wood as possible, and by using Bordeaux mixture, and a winter wash, affected trees could be completely cured. A demonstration of spraying against "Brown Rot" was given this season in an orchard of Flemish cherries at Egerton. Two sprayings of Bordeaux mixture were given. The sprayed trees gave double the yield of the unsprayed.

The Apple Powdery Mildew was most conspicuous in the "spurs" and on the young leaves, which it covered with a white powdery mildew, very similar to the hop "mould." Certain varieties, *e.g.*, Bismarck, might be attacked so virulently that the growth of the tree was stopped. In the autumn the fungus was found on the young wood, which it covered over with a whitish layer, so that the affected twigs looked almost as though they had been white-washed. This whitish covering was the spawn of the fungus; and either remained dormant through the winter, and then produced fresh spores in the next season, or it produced a special form of fructification containing winter-spores. The disease could be prevented by spraying the leaves with "liver of sulphur" or with the ammoniacal solution of copper carbonate, and the diseased wood (in winter) with copper sulphate.

AMERICAN GOOSEBERRY MILDEW IN ENGLAND.

The last fungus disease mentioned was the American Gooseberry Mildew. This, he said, was first introduced into Europe in 1900, when it was reported from three gardens in Ireland; it has now spread to hundreds of gardens all over the eastern half of Ireland, and also to several countries on the Continent. In the United States—its native home,—the present fungus has practically prevented the growing of the European gooseberry for commercial purposes. "Only a few days ago," the lecturer said, "I was able to say that so far England was free from the disease. I have now a very serious report to make; I have found the fungus in an English nursery on standard gooseberry bushes, on *Ribes aureum* stocks, lately imported from the Continent. Unless the prohibition of the importation of gooseberry bushes and *Ribes aureum* from

foreign countries and from Ireland can be obtained from the authorities, it will be only a question of time before gooseberry growers throughout England have a new and destructive fungus disease to fight."

At the close, Mr. Cecil Hooper, of Shoreham, proposed, and Mr. S. H. Hart, of Kingsnorth, seconded, a resolution calling upon the Board of Agriculture to take immediate steps to prevent the importation of the disease by the prohibition of the importation of *Ribes grossularia* and *Ribes aureum*, and also to secure the destruction of all infected stock in this country. This was unanimously carried.

Mr. Hardy, at the close, expressed the thanks of fruit growers to Mr. Salmon for the useful information he had imparted, and to Mr. Hammond for preparing the photographs. He most cordially agreed with the resolution, and he did not think they could express themselves too strongly on the matter.

WEATHER NOTES, 1906.

The outstanding feature of the weather for 1906 was the exceptional amount of sunshine together with the high day temperatures and cold nights. The sun shone on an average for about an hour a day longer than is usual.

The year taken on the whole was a warm one. Although until midsummer the readings were below the average this was fully compensated for in the last six months. The last day of August and the first two days of September were especially warm, being in the shade 88°, 87° and 85° respectively.

Two months, April and December, were unseasonably cold.

April and the first fortnight of May was an especially trying time for fruit growers, late frosts doing a considerable amount of damage, but not nearly so much as the cold drying winds.

The rainfall for the year was 25.77 inches. During June, July and August a total of only 2.98 inches fell. Hops, mangolds and potatoes suffered greatly from the effects of the prolonged drought.

The abnormal mildness lasted up to Christmas night. Then we experienced five days of the old-fashioned winter weather, snow falling to a depth of eight inches. This short spell of winter broke up as suddenly as it came, so that 1906 went out true to its record.

MONTHLY NOTES, 1907.

JANUARY.

A very dry month with more than the average amount of sunshine, the first half of the month being warmer than is usual and the second half colder. On the warmest day the thermometer in the screen rose to 48° , and on the coldest night 16° of frost were recorded.

Rail, snow, and hail fell on seven days, making a total of only 1.13 inches. The sun shone on an average two hours a day.

On three days only was a high wind experienced, the wind during the rest of the month being unusually light.

FEBRUARY.

A cold, dry month with an average amount of sunshine. This was the coldest February for five years. The lowest reading on the grass showed 19° of frost.

Rain, sleet and snow fell on nine days to a depth of 1.15 inches, being nearly an inch short of the average. The sunshine averaged two hours five minutes a day.

The wind, although rather strong for a few days from the N.W., was light on the whole for the month.

MARCH.

Dry, warm and very sunny. The day temperatures for the last three weeks were rather high, and the nights cold. The temperature for the last four days ranged between 63° and 69° , being exceptionally warm.

The nights were almost all cold, there being 12° of frost on the morning of the 21st. Rain fell on ten days to a depth of only .755 inches. The sun shone every day except one, making an average of 6.2 hours a day.

One noticeable feature as regards the wind, was the absence of easterly winds.

STAFF PUBLICATIONS.

Since the issue of the last Journal the following papers, etc., of members of the Staff have been published :—

By M. J. R. DUNSTAN.

1. Romney Marsh Sheep (Journal of the Board of Agriculture).

By F. V. THEOBALD.

The following have appeared since the last Report :—

1. A Monograph of the Culicidae or Mosquitoes. Vol. iv., pp. 639 + xix., 297 figures and xiv. Plates (1907). (£1/15/0).
2. The Wheat Midge (*Diplosis tritici*). *The Agricultural Gazette*. (February, 1907).
3. A New Megarhinus (*Megarhinus herrickii*). *The Entomologist*. Vol. xxxix. No. 522, p. 241. (November, 1906).
4. Mosquitoes or Culicidae. *System of Medicine* (Sir Clifford Allbutt). Vol. ii., pp. 122 to 168. (1907).
5. The Frit Fly (*Oscinis frit*). *Agricultural Gazette*. (September 26th, 1906).
6. Orchard and Bush Fruit Pests in 1906. *Board of Agriculture Journal*. Vol. xiii. No. 12, pp. 705-719 (1907).
7. New Hemipterous Fruit Pests in Britain. Leaf Hoppers (*Typhlocybidæ*). *Journal of Economic Biology*. Vol. ii. No. 1 (1907).
8. Report on the Orchards and Fruit Plantations of Worcestershire, with a short account of some of the worst diseases observed, and suggestions for their treatment, pp. 30 (Worcestershire Education Committee). (1906).

By E. J. RUSSELL.

1. Experimental lessons in Plant Life and Soil. *The Practical Teacher*).
2. Maize as a Fodder and Silage Crop. (*Journal of the Board of Agriculture*).
3. The Relationship between the geographical position and the productiveness of the land. (*Journal of the Manchester Geographical Society*).
4. Bacteria and Root Action (*Nature*, June 21st, 1907).

By E. J. RUSSELL and F. V. DARBISHIRE.

1. Oxidation in soils and its relation to productiveness. (*British Association Reports*).

By E. S. SALMON.

1. Apple Scab or Black Spot (*Gardeners' Chronicle*, July 14th, 1906).
2. The European Gooseberry-mildew attacking the Red Currant (l.c., October 27th, 1906).
3. The American Gooseberry-mildew in 1906; a warning to English Gooseberry-growers. (l.c., November 3rd, 1906).
4. The American Gooseberry-mildew discovered in England (l.c., November 10th, 1906).
5. The Board of Agriculture and the American Gooseberry-mildew. (l.c., December 1st, 1906).
6. The American Gooseberry-mildew. (l.c., December 15th, 1906, and *The Times*, December 28th, 1906).
7. *Idem*. (*Evesham Journal* and *Evesham Standard*, December 22nd, 1906).
8. *Idem*. (*The Fruit-grower, Fruiterer, etc.*, December 27th, 1906).
9. On Raising Strains of Plants resistant to Fungus Disease. (Report of the Third International Conference (1906) on Genetics, p. 378-382 (1907).)
10. On the American Gooseberry-mildew, and the Need for Legislation. (*Journal of the Royal Horticultural Society*, xxxi., 128-137, 1907).

11. On a Fungus Disease of the Cherry-Laurel (*Prunus Lauro-cerasus*, Linn.). (l.c., 142-146, 1907).
12. The American Gooseberry-mildew. (*The Fruiterer, Fruit-grower, etc.*, January 3rd, 1907).
13. *Idem.* (*Nature*, January 10th, 1907).
14. *Idem.* (*The Times*, January 10th, 1907).
15. *Idem.* (*Journal of Horticulture*, January 17th, 1907).
16. *Idem.* (*The Fruit-grower, Fruiterer, etc.*, January 17th, 1907).
17. *Idem.* (*The Times*, January 19th, 1907).
18. *Idem.* (*The Gardeners' Chronicle*, January 19th, 1907).
19. *Idem.* (*The Fruit-grower, Fruiterer, etc.*, January 31st, 1907).
20. *Idem.* (l.c., February 7th, 1907).
21. *Idem.* (*The Standard*, March 20th, 1907).
22. Der Ausbruch des amerikanischen Stachelbeer-Mehltaus in England. (*Zeitschrift für Pflanzenkrankheiten*, xvii. Band, S. 12-20, 1907).

By T. R. ROBINSON and WALKER TISDALE.

1. The Selection and Milking of Dairy Cattle. (*Journal of the Board of Agriculture*).
2. Farm Butter-making. (*Journal of the Board of Agriculture*).
3. Devonshire Cream and Soft Cheese. (*Journal of the Board of Agriculture*).

COLLEGE NEWS.

COLLEGE NEWS.

The College year has practically drawn to a close, and it once more falls to the lot of the Editor to report on the more important events which have occurred during that time. It was with much regret that we had to bid farewell to Mr. Orwin, who left us to take up an important appointment as land-agent on a large estate in Lincolnshire. Mr. Orwin was some years ago a student at the College, and it was no doubt due to this, that when he returned to Wye as a member of the staff, he exercised not only such a good influence over the students, but took such an active and keen interest in the College life from a student's point of view. As a token of our esteem and as an expression of the appreciation which we felt for his work, he was presented by the students prior to his departure with a silver cigarette box.

As in the former case, we have to mention with regret the departure for Canada of another member of the staff, who had also been a student at the College, in the person of Mr. Harding, to whom our very best thanks are due, for the energetic and masterly way in which he managed the sports for us during the last two years.

Mr. Annett, who left us at the end of last term to take up an appointment in India, will also be greatly missed in the Sports Field.

We had great pleasure in welcoming Mr. Haines, who has filled the post vacated by Mr. Orwin, and who will no doubt be a great addition to our strength on the Cricket Field.

The Annual Cricket Week took place in the third week of July, and though not as successful as we might have wished it to be from the cricketing point of view, the event as a social function was most

enjoyable. As usual, open-air concerts were held in the Quadrangle at the College, which proved most successful, and we feel sure were much appreciated by the large audience present on each occasion.

We must heartily thank all those ladies and gentlemen who so ably assisted.

On Wednesday evening, Mrs. F. Cave, Mrs. H. S. Wainwright and Mr. K. C. Stracham gave a farce entitled "Man Proposes," which was most amusing, and much appreciated. On the following day the dance, which is the chief event of the week, took place, and again proved most enjoyable, Mrs. Dunstan's capabilities as hostess ensuring success. On Friday evening Mr. F. C. Timins and Mrs. Ellison gave us the benefit of a charming little play entitled "Jerry and the Sunbeam." We must take this opportunity of conveying our very best thanks to Mrs. Dunstan, who acted as hostess during the festive week, and also to Miss Price, who spared herself no time or trouble in her efforts to ensure its success.

This year a new feature in College Sports took place in the form of a boxing competition. Mr. A. V. D. Rintoul has presented a cup, which is to be competed for annually, and this was won on this, the first occasion, by G. Talbot after an exceedingly hard struggle, which was materially emphasised by the gory state of his nasal organ. E. W. Morrell competed in the final round.

Apropos of Cricket, we are glad to hear that the services of a ground man have been obtained, for it will, we feel sure, be a great load taken off the shoulders of our able Secretary, Mr. T. C. S. Johnstone and others of the Committee; another improvement which will save a lot of time and trouble and which has been a long felt need, is the laying on of a water supply to the cricket field.

The Principal again very kindly lent his table for the Annual Billiard Tournament towards the end of the Easter term. Mr. Beazley won the first prize.

The Bathing Committee have apparently come to the conclusion that any improvement down at the bathing place is either unnecessary or else impossible, for there has been nothing done during the past year to rectify the gross state of mud which prevails near the

banks. However, we congratulate the Committee on the erection of a spring board, which they have accomplished; we are also glad to hear that an attempt has been made to start a Water Polo team, which attempt we hope will be successful.

The Gymnasium has now been fitted up with the necessary appliances for gymnastic exercise, and also a movable stage has been constructed for any entertainment which may be held in that building.

During the year ending March 1907, the highest number of students yet recorded attended the College, 114 being in attendance during the autumn term; the following students joined the College:—D. V. Bacon, E. Barrow, G. E. Bath, S. M. Bertie, P. Blagrove, H. H. Bowen, D. Burton, E. J. Carlisle, H. F. Carter, E. R. Cave-Browne, E. G. Chamberlaine, T. G. O. Cole, T. E. Crompton, J. C. Curtis, A. G. Cutler, B. T. Dane, L. M. Davenport, E. H. Davies, O. J. Escalada, C. S. Field, H. F. Foster-Pegg, E. L. Frank, G. H. Garle, Eugène de Grunne, R. F. Hankins, E. Hardy, R. M. Hardy, C. F. M. Humbert, G. R. Jackson, H. C. Keable, E. B. Keiller, C. Kerr-Pearse, A. G. Letchworth, J. M. Manapat, A. D. McKinstry, M. D. McNeill, D. M. McCaul, J. D. A. Munro, H. B. Redmayne, W. F. Riley, A. V. D. Rintoul, F. B. Ryder, C. P. Salvago, E. C. Simon, C. E. Slater, J. W. Stayner, G. G. Talbot, W. S. G. E. Tremayne, W. R. Tucker, A. H. Vernède, C. Vetch, W. P. de Vries, G. B. Wallace, C. L. Walters, G. B. Wheeler, T. B. Worthington.

The following students left the College:—K. F. G. Alford, H. E. Annett, J. H. Baldwin, G. E. Bath, J. H. Beazley, I. T. N. Bertram, E. T. Bruce, D. Burton, I. N. Campbell, E. G. Chamberlaine, T. G. O. Cole, H. A. W. Cole-Hamilton, B. S. Collard, P. Cooper, I. S. E. Crabbe, H. G. Crumplin, J. C. Curtis, H. F. Dalton, G. H. Drummond, O. J. Escalada, E. G. Fisher, K. G. Furley, J. Mc. D. Garlick, G. H. Garrad, E. O. Greening, Eugène de Grunne, J. F. Harrison, W. G. Heymann, C. W. Hurley, J. P. Jepson, C. Kerr-Pearse, F. W. Lee, W. E. Marsden, C. W. Mason, D. M. McCaul, W. McGowan, A. D. McKinstry, C. F. Nixon, J. L. Ocampo, W. W. Palmar, S. F. Pearson, W. A. L. Richardson, A. G. Culme-Seymour, C. J. Sherwin, A. V. Spencer, C. W. Stanley, F. N. Sutton, A. H. Vernède, R. S. Vinson, G. B. Wallace, E. G. Wheeler.

The prizes, diplomas, etc., were distributed on July 18th, 1906, to the successful students, by Countess Carrington (in the unavoidable absence of Earl Carrington, President of the Board of Agriculture), who was accompanied by Major Craigie, C.B., an assistant secretary of the Board. Particulars of the awards will be found on pages 394-6.

MUSICAL AND DRAMATIC ENTERTAINMENT.

Great was the success which attended a musical and dramatic entertainment given in the Gymnasium on the evening of December 13th. The whole thing was on a larger scale than most entertainments, which have been given at the College of recent years. A great addition to the performance was a full orchestra and chorus.

The first part was musical, and its excellent arrangement and management was entirely due to Mr. R. Hart-Synnot.

Two ladies, Mrs. Colville and Miss Knollys, very kindly assisted with delightful songs. Two plantation songs by Mr. W. Hopkins and the Chorus were very good, and the glee, "Sweet and Low," was prettily sung. Mr. R. Hart-Synnot and Mr. L. Hopkins sang a charming duet, and their solos were also very much appreciated. A piano solo was excellently played by Mr. W. Butler, who also accompanied most of the singers. Great praise was due to both orchestra and chorus, the former consisting of Messrs. M. J. R. Dunstan, E. R. Cave-Brown, R. Hart-Synnot, W. Butler, G. A. Goodman, W. Hopkins, T. E. Crompton, J. C. Curtis, D. M. McCaul and Dr. Darbishire; whilst the Chorus was formed of Messrs. H. W. Kersey, R. Hart-Synnot, F. K. Willis, C. B. Saunders, M. J. R. Dunstan, L. Hopkins, L. E. Knollys and R. G. Chandler.

The second part consisted of a performance of "Vice Versa," which has been dramatised from Anstey's well-known book. It is not an easy play to act, as there is some difficulty in the change from father to son, but this was admirably managed by Mr. L. Hopkins and Mr. C. W. Jemmet. Mr. L. Hopkins took the part of "Dick Bultitude's body," which was inhabited partly by Dick's spirit, but during the greater part of the play by his father's; his acting

left nothing to be desired. Mr. Jemmet was amusing as "Mr. Bultitude's Body," inhabited mostly by his son's spirit, and his acting was most commendable. Mr. Shellack was very ably taken by Mr. L. E. Knollys, and it was a pity that his part was not longer.

Mr. S. Rothwell made a very good cabman; he also took the part of "Tipping" one of the boys. The other schoolboys were played by Mr. C. B. Saunders, who was excellent as "Chawner," Mr. D.G. Stone, Mr. R. P. Pierce, and Mr. A. G. Letchworth. They all entered into their parts with great spirit. Mr. A. V. Spencer took the part of "Dr. Grimstone, the Schoolmaster" exceedingly well.

The get-up of the two "ladies" was extremely good, and did them great credit. Mr. R. S. Biscoe as "Dulcie" was much appreciated, and really acted very well indeed. He seemed well acquainted with the ways of the fair sex. The part of "Eliza, the servant" was excellently taken by Mr. S. E. Baxter.

Our best thanks are due to Messrs. E. P. Morgan and E. C. Simon, who made the stage entirely, and who arranged all the lighting and other accessories, which went a long way towards making the entertainment as charming as it proved to be.

The orchestra played very well, and greatly added to the effect of the play, which was admirably managed and arranged by Mr. R. Hart-Synnot and Mr. R. S. Biscoe, to whom our best thanks are due.

LAWN TENNIS.

Exclusive of the two matches between Staff and Students, both of which were won by the former, four matches were played, two against St. Augustine's College, Canterbury, one against Mr. T. H. Oyler's team, and the annual match on Rose Show day against Mr. J. Turner Welldon's team. The College only succeeded in winning the match against the team brought over by Mr. Oyler, but on both days against St. Augustine's the College was not fully represented.

Mr. Welldon's victory was a very close thing, the result being five matches to four, the deciding match running to three sets.

The teams were chosen from H. F. Dalton, F. G. Hall, L. Hopkins, H. W. Kersey, E. W. Morrell, C. S. Orwin, and E. S. Salmon. Mr. Salmon was a great acquisition to College Lawn Tennis; he plays a strong game in both singles and doubles, and materially strengthened the College team.

GOLF.

A match was played against the Ashford Golf Club, the College losing by the narrow margin of one-half; 1 point was scored for the match and $\frac{1}{4}$ for the bye.

The teams were very kindly invited to tea by Mr. Charles Igglesden, Captain of the Ashford Golf Club, on the conclusion of the match.

ASHFORD.		WYE.	
R. H. N. Ellison.....	1	J. W. Lewis.....	0
S. B. Winch.....	$\frac{1}{4}$	C. Vetch	1
J. Sandy	$\frac{1}{4}$	H. W. Kersey.....	1
C. Norwood	0	G. Jackson.....	$1\frac{1}{4}$
C. Igglesden	1	M. J. R. Dunstan	0
N. R. Raven	$1\frac{1}{4}$	W. H. A. FitzRoy.....	0
L. Coke	1	A. H. J. Haines.....	0
C. A. Wickham	1	K. G. Furley.....	0
L. P. Headley.....	0	G. G. Talbot.....	$1\frac{1}{4}$
F. Coke	0	M. D. McNeill.....	$1\frac{1}{4}$
G. H. Igglesden.....	$\frac{1}{4}$	E. J. Carlisle.....	1
C. H. Igglesden.....	$1\frac{1}{4}$	T. C. S. Johnstone.....	0
	$7\frac{1}{4}$		$6\frac{3}{4}$

CRICKET.

On the whole, the season was a fairly successful one. Out of the eighteen matches played, ten were won, seven lost, and one drawn. As in last year's Cricket Week, the College only managed

to win one match out of four. C. W. Mason again captained the team.

This year for the first time a second eleven was formed, captained by C. J. Sherwin; seven matches were arranged, of which four were won, two lost and one drawn.

The teams were as follows:—

First XI.—C. W. Mason, W. G. Heymann, W. H. A. FitzRoy, N. Haig, E. W. Morrell, H. A. Clive, R. G. Chandler, C. B. Saunders, C. W. Hurley, H. Tonks, R. S. Vinson.

Second XI.—C. J. Sherwin, T. C. S. Johnston, W. E. Marsden, A. G. Culme, Seymour, F. H. Vaughan, A. V. D. Rintoul, N. H. Mount, F. K. Beazley, S. F. Pearson, G. H. Garrad, J. W. Lewis.

RUGBY FOOTBALL.

The Rugby Club did not experience such a successful season as in 1905. Five matches were won and five lost: the clubs defeated being King's School, Maidstone, Hythe and Sutton Valence School; whilst reverses were sustained at the hands of Dover College, King's School, Maidstone, Hythe and Canterbury. The defeat by Hythe was the first on our ground for two seasons. L. Hopkins proved a most able captain.

The team was as follows:—

L. Hopkins, W. G. Heymann, F. H. Vaughan, J. D. Yeatman, C. W. Jemmett, H. Tonks, H. W. Harding, A. Amos, M. W. Colomb, R. P. Pierce, E. H. Davies, E. R. Cave-Browne, W. R. Dunlop, J. R. Cheeseman, C. B. Saunders.

The following also played in some of the matches:—A. G. Letchworth, G. G. Talbot, G. R. Jackson, D. V. Bacon, C. Vetch, L. E. Knollys, J. W. Stayner.

Our thanks are due to Mr. Haines for refereeing in all the home matches.

ASSOCIATION FOOTBALL.

The past season was a most successful one, the College team only losing one match during the season. Thirteen matches were played, out of which eight were won, four drawn, and one lost.

The total number of goals, scored by the College was sixty-one, against our opponents' total of fifteen.

The team was captained by F. P. Jepson.

The following represented the College :—J. W. Stayner, *goal* ; G. R. Jackson, E. W. Morrell, *backs* ; D. G. Stone, F. P. Jepson,* W. B. Burgess,* *half-backs* ; W. P. de Vries, S. Rothwell,* H. E. Annett,* C. P. Salvago, R. G. Chandler,* *forwards*.

The following also played :—G. G. Talbot, G. Fenoulhet, J. D. A. Munro, O. J. Escalada, W. G. Heymann, M. D. McNeil.

Colours were awarded to :—J. W. Stayner, G. R. Jackson, D. G. Stone, E. W. Morrell, W. P. de Vries, C. P. Salvago.

HOCKEY.

The Hockey Club ended with a fairly successful season of seven wins and five losses. Owing to the frost several of the earlier matches had to be scratched. The team, ably captained by H. Tonks, was as follows :—H. A. Clive, E. W. Morrell, G. R. Jackson, E. P. Morgan, H. W. Harding, C. B. Saunders, A. Amos, L. Hopkins, J. W. Stayner, S. Rothwell, and H. Tonks.

The thanks of the College are due to Dr. Coke, who kindly came over from Ashford and refereed in most of the matches.

The "A" team, with R. S. Biscoe as captain, won three and lost five matches. The team was composed of :—W. H. A. FitzRoy, J. B. G. Burchett, F. H. Vaughan, W. B. Burgess, Dr. Darbishire, W. Riley, N. H. Mount, H. E. Annett, E. R. Cave-Browne, L. E. Knollys, R. S. Biscoe, G. G. Talbot.

STEEPLECHASE.

The College steeplechase was run on March 20th over the same course as last year. There was a large number of entries, which goes to prove that the keenness shown on the same event last year had by no means dwindled on this occasion.

* Old colour men.

There was a strong wind blowing at the time, which no doubt helped considerably to separate out the field at the beginning, and by the time the water-jump was reached W. H. A. FitzRoy was well ahead, and finally secured an easy win, followed by A. G. Letchworth, who ran a very good second. E. O. Greening took third place, whilst H. C. Keable finished fourth.

The annual Sports were held on the following Saturday, under the most favourable conditions as regards the weather, which reminded one more of midsummer than of spring.

The entries were unusually good, there being no less than twenty-six in the obstacle race alone. The prizes were given away on the field by Mrs. Cornwallis, of Linton Park, to whom our best thanks are due for her kindness. The Challenge Shield was won by W. H. A. FitzRoy, with two firsts and two thirds. The tug-of-war between the Staff and Students resulted in a win for the latter, owing possibly to lack of practice and training on the part of the staff, and also to a slight misunderstanding which occurred.

The Half Mile Obstacle Race, a new event on the programme, was very well arranged, and afforded a great deal of amusement; the great feature of the race was a board, six feet broad by fourteen feet long, having one end raised ten feet from the ground, twenty-eight pounds of soft soap were used to grease the board, over which the competitors had to get as best they could.

The results of the other events were as follows :—

100 Yards—E. W. Morrell, H. Tonks.

Throwing the Cricket Ball—J. W. Stayner, R. G. Chandler; distance, 88 feet 6 in.

Quarter Mile—H. Tonks, E. W. Morrell; time, $60\frac{1}{5}$ secs.

High Jump—N. H. Mount, L. Hopkins; height, 4 feet $11\frac{1}{2}$ ins.

120 Yards Hurdle Race—L. Hopkins, E. W. Morrell; time, 19 secs.

Half Mile—W. H. A. FitzRoy, W. McGowan; H. Tonks.

Putting the Shot—S. Rothwell, C. P. Salvago; distance, 29 feet 1 in.

600 Yards Handicap—E. H. Davies, E. J. Carlisle.

Long Jump—N. H. Mount, R. G. Chandler; distance, 18 feet 6 inches.

Old Students' Race—H. W. Harding, L. Doubleday, K. G. Furley.

Mile—W. H. A. FitzRoy, W. McGowan, A. G. Letchworth : time,

Obstacle Race—R. G. Chandler, J. D. Yeatman, R. N. Dowling.

The consolation races were won by R. N. Dowling and R. S. Biscoe.

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Secretary	-	C. B. Saunders.
		H. Tonks.
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Captain A team	-	R. S. Biscoe.
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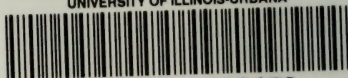
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